RAILROAD GAZETTE

FRIDAY, AUGUST 20, 1897.

CONTENTS

Contributions.

Triple Screw Propellers.

WASHINGTON, Aug. 10.

TO THE EDITOR OF THE RAILROAD GAZETTE:

With reference to your notice on triple screw propellers in your issue of Aug. 6, pp. 559-560, I beg to call your attention to an address and lecture on the German navy by Professor Busley, published in the *Zeitschrift des Vereins Deutscher Ingenieure* of Aug 8, 1896. On page 894 is given a table of results referring to the trial trips of the three-screw cruiser Kaiserin Augusta. Three screws have been found less economical than two, etc.

TH. HOECH, M. Anr. Soc. C. E.

The Milwaukee & St. Paul Weed Burner.

Chicago, Milwaukee & St Paul Railway,
ABERDEEN, S. Dak., Aug. 13, 1897.

TO THE EDITOR OF THE RAILROAD GAZETTE:

We are using a weed burner on our branch lines. The device consists of a tank with a capacity of about 12 barrels of crude oil placed on a flat car from which by means of pipes the oil is conveyed to the burners at the end of the car. There are eight of these burners, four between the rails and four outside of the rails. Air is used to furnish the necessary blast, and is supplied by air pumps on the locomotive with which the car is handled. We have also tried steam, and it is a question which is the more satisfactory. We burn from eight to ten miles a day, using about one barrel of oil per mile.

We figure that about three burnings a season will keep the weeds down so as not to interfere with trains, and that one machine will take care of about 200 miles of track. At the end of the season we expect to have to do some trimming up with the shovel. The entire crew with our machine consists of four men, three of them with the locomotive and burner, and one man follows behind to extinguish any fires that might be started. The expense of burning as compared with cutting by hand is not over one-half, and I think that in time the machine will be improved upon so as to do still better work and more of it.

C. H. SCOTT, *Superintendent.*

The Subsistence Question in the Klondyke Region.

TO THE EDITOR OF THE RAILROAD GAZETTE:

The situation in the Klondyke region is in some respects similar, as regards subsistence, to the situation that existed in the Selkirk Range, west of the Rockies, in the winter of 1884-5, prior to the construction of the Canadian Pacific Railway. The end of the track of the railroad (corresponding to the end of water transportation at Dyea) was on the west slope of the rockies, in the Kicking Horse Valley. Some 50 miles beyond lay the Selkirk Range, which the railroad was to cross at an elevation of about 4,000 ft. above sea level. This range had the name of being one of the most difficult ranges in the Northwest to cross even in summer and on foot. It was covered with fallen timber of great size, trees of 8 and 10 ft. diameter sometimes lying two or three deep. No feed grew there for pack animals, except for a few weeks and in a very few places. The slopes of the valleys of the Beaver and Illecillewæt rivers were marked with traces of hundreds of snowslides. The Indians of that region could never be induced to cross the range after October. The old guides, returning eastward from the range in October, insisted that the snowslides would destroy any parties sent in there in the winter. The average yearly snow-fall on the upper part of the Selkirk Range is 25 ft., giving from 8 to 10 ft. depth of settled snow on the level.

A pack trail had been completed across the range by the fall of 1884, and the wagon road had been advanced part way up the east slope of the range. In October orders came from Montreal to attempt at least some parts of the work on the range. These were the heavy work intended to be built at the Albert Canon on the west slope; the completion of the wagon road across the range to a connection with the road from the west, and the forcing in of supplies over the route as far as possible. The writer was ordered to take charge of the advance work on the west slope, and to see that ample supplies were taken in, for which work abundant pack trains were provided.

In any such country the question of feed for the animals is the limiting factor. If the country produces this, supplies can be transported an indefinite distance. If no feed is found growing there, in a few days the animals will "eat the packs off their backs," delivering nothing beyond. Therefore the advance of the wagon road is necessary, over which many times as much per animal can be transported. This was accomplished on the Selkirk Range, so that by the end of December ample supplies had been placed at winter quarters on the west slope. After that the wintering was accomplished in comfort—in tents for much of the winter, and later in cabins. With abundant supplies, temperatures of—40 deg. Fahr. were not severely felt; and doubtless the low temperatures which appear to be so threatening in the Klondyke region will be endured in similar comfort by those who have supplies. A duck tent of single thickness could be made warm enough by a sheet iron box stove of ordinary size. In the Klondyke, as elsewhere, it will probably be a problem of food rather than of temperatures. The papers made the same terrifying predictions about the Selkirk cold that are now being made about the Klondyke cold. In the Portland *Oregonian*, which I received via Winnipeg while on the Selkirks, the statement was made that human life could not stand the intense cold of a winter in such a region. I read that paragraph in the dead of winter in my cabin on the Selkirks, in an upper room without a fire, and with my coat thrown off because of the excessive heat from the rooms below. There is no cold which cannot be comfortably met by the man who has ample supplies of food and moderate supplies of fuel and clothing, even if his shelter be very inferior. With such supplies, the cold weather in most cases will be found a tonic to the system. It is not a question of the cold or of the snows, but of transportation.

The construction of the Selkirk wagon road was continued westward during the winter, and the road was connected with the road from the west in December. Temperatures of —35 deg. Fahr. were experienced during this construction, but did not stop the work. Such a wagon road is made largely by clearing and grubbing, with moderate amounts of earthwork, and some rockwork at peculiarly difficult points. The small proportion of earthwork permits the work to go forward, the work other than earthwork being readily done in cold weather. For a road to be used chiefly for sledding, and where heavy snows are expected, the grubbing may be very much reduced.

The winter time, which is being pointed to as the obstacle to advancement into the Klondyke region, is really just the time to make such an advance by the overland route, if that advance be properly organized and pushed. In transportation, as in logging, winter is the time for work. Sleds will carry much greater loads over the snow than wagons will take later on rough roads. The snowslides caused only temporary interruption on the Selkirk Range. The slides that went far below the wagon road (or "tote road," as it is termed) left in general only moderate amounts of snow on the road. The slides which came to rest near the road, leaving a great depth of show on the road, did not permanently interrupt travel. The snow was soon packed hard enough for teaming to be done over it as usual. It is stated that east of the Chilkat Pass, the winter snowfall is only about 3 ft.; the topography of the country is not such as to create many large slides.

On the Rockies and Selkirks there were a few gradients, adverse to the haul, of 20 ft. per hundred, the difficulties being massed where helpers could be used readily. The Chilkat Pass, altitude 3,500 ft., shows 11 miles on one slope and 10 miles on the other, or more than sufficient sustaining ground to give reasonable gradients for a wagon road, without deviation of route.

In attempting a comparison of the Klondyke overland route with the Selkirk transportation, we are at a disadvantage, owing to the variations in miners' estimates of distances. Approximately the route appears to be as follows:

Dyea to head of navigation	6 miles
Southwest slope of Chilkat Pass	11 "
Northeast " " "	10 "
On Lake Linderman	8 "
Portage	1 "
On Lake Burnett	26 "
Portage and Caribou River	3 "
On Lake Tagish	17 "
Portage to Marsh Lake	3 "
On Marsh Lake	24 "
On White Horse River to the rapids	27 "
" " " below the rapids	30 "
On Lake Le Barge	31 "
On Louis River	62 "
By land to Fort Selkirk (at the junction of the Louis and Pelly rivers, forming the Yukon River)	200 "
Total to the Yukon	459 "

Thence down the Yukon and up its tributaries by boat, from 100 to 150 miles, according to the location of the mine or claim. As ten or a dozen claims would take up a mile of river under the old regulations, and as there are several thousand men already holding claims, a statement as to how far a man may have to go to reach his journey's end is necessarily an elastic affair by 50 or 100 miles The last 25 or 50 miles would probably be on land. (The 200 miles of land travel to Fort Selkirk is given by some miners; others appear to travel this distance by boat.)

The Klondyke overland route thus includes three important stretches of land travel, namely, at the Chilkat Pass, at the portion before Fort Selkirk is reached, and at the terminus of the journey. The first two stretches are traveled by all, and are a matter for public improvement; the last stretch will probably be a matter for pack horse work by the individual miner. The public route, with the exception of the first two stretches of land travel, is one affording a natural road in winter of the best sort of sledding, on frozen lakes and rivers, with a few short places requiring improvement. The blockade of which we hear most is that of the Chilkat Pass, where great numbers of men en route appear to be lying idle, awaiting the few Indian packers who are available, and who are charging from 15 to 25 cents per pound for packing the 27 miles to Lake Linderman. Thence the route is by boats, poor affairs made on the ground out of green whip-sawed lumber. This mode of transportion was attempted on the Columbia River, east of the Selkirks, where the rapids were much less formidable than the North Western Rapids are reported to be; but even the deep mud of the wagon road in spring was preferred by all but a half dozen parties. Anyone who has felt the power of water in the rapids of a mountain stream is apt to have too much respect for it to select such a transportation route if any other can be found.

We hear but little of the blockade at the stretch of land travel before Fort Selkirk is reached. It may be more serious than the Chilkat blockade, being further from feed for horses and from the large body of packers or this stretch may be covered by boat by most of the parties. Some of the writer's acquaintances in the West are arranging to use both horses and dogs, the former at the Chilkat Pass, the latter in the later journey; the horses being killed for dog meat after the Chilkat transportation is completed. But dogs cannot be procured in sufficient numbers to meet the great demands of the situation. The probability is that the great mass of supplies will be transported to the Klondyke region by winter transportation. Can this be done?

The difficulty of doing this by pack animals can be readily shown. Allowing only 20 lbs. of feed per day per pony, and a load of 240 lbs. per animal, in 12 days the pony has "eaten his load off his back," and must then be left to die, with no surplus delivered and nothing accomplished. This is just what happened in cases on the Selkirk Range, before the wagon road had been advanced; dead ponies were numerous along the trail. To place even 100 lbs. per animal at the mines, a pack train must make the journey in less than seven days. The journey, even with the aid of water transportation, now takes over three times that length of time. In winter it has been known to take over 60 days.

On the other hand, assuming that a sled and team can take 3,000 lbs. over a good sled road to the mines in about 20 days, we have about 800 lbs. of the load consumed by the team, and 2,200 lbs. delivered. This is about a year's supply for a miner.

The weak point in the present situation appears to be the disorganized, individual character of the efforts to enter the country. At Dyea, over 3,000 men are now said to be lying idle, awaiting packers. A tenth part of this number could construct a sled road across the Chilkat Pass in a few weeks, even if much rock work had to be done. No more provisions would be consumed by them than while lying idle. The Indian packers are too few to oppose effective resistance to such a construction; and the Pacific Coast Indian is not of the right make-up for a fight. There is a report that a company is being formed at Juneau to improve the transportation arrangements. A few weeks of work west of Fort Selkirk would probably secure a sled road at that stretch of land travel. For the rest of the distance, the winter will make the sled road. The eagerness to get to the mines this summer will probably prevent a proper combined effort until fall shows the blockaded parties the need of orgnized effort. Those who force their way in after August will reach the mining region poorly provided with supplies, worn out by their efforts to get in, and too late to prospect before snow. Those who go more deliberately and intelligently, after aiding in the construction of a sled road, will arrive in comparative comfort, better provided with supplies, with ample time in the winter to make a good general selection of country in which to seek a claim; and they will be on the ground before the arrivals by boat on the Yukon.

If there be only 3 ft. of annual snowfall in the Yukon country, as reported, there may be more wind than is generally experienced in regions of heavy snow, the latter being generally windless in winter. Continuous sledding, which the large travel will secure, will overcome this difficulty and keep the road open. The possibility of delivering supplies by vessels in the Yukon region part of the year is an obstacle to the construction of a good overland sled road, as is also the prospect of a railway route, both of these routes making the sled road a temporary affair.

The cost of a wagon road in mountain country, similar to the Selkirk Range, with wages, not including board, $1.75 per day, may be taken at $1,800 per mile maximum, with a rate as low as $100 per mile on fairly level easy stretches, and at locations about 150 miles from the base of supplies. If there be only 3,000 tons to be transported, and if only 20 cents per pound be saved by the construction of 250 miles of sled road, the economy

of its construction can readily be calculated. For men en route with their supplies, a rate of $1.75 per day would be a good figure, as they would probably work for the cost of their subsistence, in order to save their own stores of food. Sleds are readily made in the woods by an expert woodsman with axe and auger. I have had one made in a half day that would carry a ton. To handle 4,000 tons, including feed, several thousand horses would have to be shipped to Dyea, if the horses were to be sold at the mines, making no additional trips. With probably five round trips possible, a much smaller number would answer, depots of supplies of feed being established for the return trips.

Those who rely upon making an early entrance by the land route into the Klondyke region after the streams are open for boating will probably make a mistake. The break-up in these upper tributaries of the Yukon will occur much later than in the lower Yukon, and vessels will probably reach Dawson City before the upper streams on the overland route have subsided from the freshets and have become navigable safely. In the late spring the ice will become rotten and an interval of cessation of transportation occur. The road will be neither sled road nor wagon road for a time under the melting snow and spring rains. The late spring for the overland route must be the worst possible time, judging from experience elsewhere. The winter may be found the best possible time under proper organization and with proper effort.

ARCHIBALD A. SCHENCK.

Electric Motors at the Ramapo Iron Works.

In following up the subject of the installation of small electric motors for driving machinery, we have found much of interest and value in examining their introduction at the Ramapo Iron Works, Hillburn, N. Y. As in many other shops, the long line shafting has been discarded and each machine or each small group of machines is run by a motor. Here we also find that a small percentage of the tools are required to be in constant use, so that under the new arrangement only as much power is used as is required to operate the machines when in service, while formerly much power was wasted in running idle shafting. Except in the case of entirely new buildings or in the addition to old ones, the introduction of the electric motors has been very gradual.

The entire plant covers about 12 acres and the total floor area of the shops is about 100,000 sq. ft. The products are frogs, switches, stands, crossings, cars, brakeshoes, miscellaneous castings and general track supplies. Being situated on a narrow neck of land between the Erie Railroad and the turnpike it was necessary to spread the buildings out along the line of track, which, of course, enables the material to be handled very conveniently. The railyard, in which is kept a stock of about 80 different sections, is at the north end, on the west side, and next to this is the saw shop, and immediately following, as will be seen from the accompanying figure, are the planing and erecting shops. In the latter the material is handled by an electric crane of 5 tons capacity covering an area of 25 ft. × 140 ft. It will be observed that the buildings on the east side of the track are also arranged so that the finished product from one department can be taken directly into another building where the work progresses without unnecessary interruption.

The steam for the plant is generated by one 60-H. P. and one 150-H. P. horizontal tubular boiler at a pressure of 80 lbs. and two 150-H. P. horizontal tubular boilers at 125 lbs. pressure. The power is furnished by two engines: One is a Wetherill Corliss of 170 H. P., operating main shaft through switch and frog planer shops and air compressor, and the other a 150-H. P. Westinghouse compound engine operating a Westinghouse continuous current dynamo rated at 500 amperes and 250 volts, or about 168 H. P., running at a speed of 700 revolutions per minute.

The motors are distributed as follows:

Saw Shop.—One 10-H. P. Lundell, running three rail saws and a saw grinder.

Switch Planer Shop.—One 10-H. P. Lundell, running three drills, a bender and an emery wheel, and a 25-H. P. Lundell, running heater fan.

Pattern Shop.—One 7½-H. P. Lundell running circular saw, turning lathe and face plate, and one 2-H. P. Lundell running jig saw.

Frog Erecting Shop.—One 10-H. P. Gibbs running punch and shear; one 7½-H. P. Lundell running three-radial drills, a rail bender and a grindstone; two 10-H. P. Westinghouse running eight-emery wheels, and one 3-H. P. Lundell running rail saw.

Store House.—One 10-H. P. Lundell running shear.

Foundry.—One 35-H. P. Lundell running two blowers for stacks, three cinder mills and a hoist.

Machine Shop.—One 10-H. P. Lundell running five-engine lathes, one speed lathe, two crank lathes, shaper, milling machine, three planers and two radial drills; a 7½-H. P. Gibbs running two-turret lathes, and a 3-H. P. Lundell running two-pipe cutting machines.

Blacksmith Shop.—One 10-H. P. Lundell, running punch and shear; 5-H. P. Lundell, running emery wheel; ¼-H. P. Lundell, running small drill; 12¾-H. P. Lundell, running blast and part of machine shop; 20-H. P. Lundell, running blast; 15-H. P. Westinghouse, running heater fan; 15-H. P. Westinghouse, running bolt plant, drop hammer and trimmer, and a 15-H. P. Westinghouse, running bulldozer.

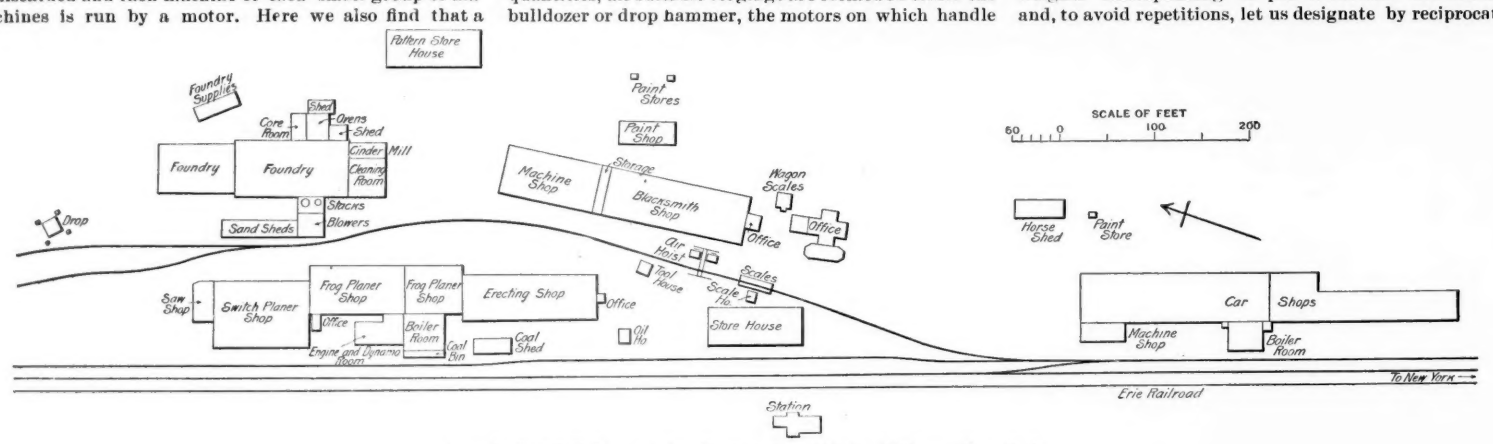
Car Shops.—One 50-H. P. Westinghouse, running four-sided planer; 25-H. P. Lundell, running circular saw; 25-H. P. Lundell, running cut-off saw and tenoning machine; 15-H. P. Lundell, running boring and gaining machine; 5-H. P. Lundell, running radial drill, bolt cutter, small drill and emery wheel; 15 H. P. Westinghouse, running mortising machine and band saw, and a 30 H. P. Westinghouse, running shaving blower.

The longest electric circuit is 2,200 ft. This main is composed of two lines of 0000 (B and S gage) wire and the voltage is kept at 225 at the dynamo. Switchboards are conveniently located in all the shops, and each is supplied with an automatic cut-out. A current is used during the day time for lighting the fireproof vault and the engine and boiler rooms. When used thus, four 50-volt lamps are placed in a series. When required in large quantities, all suitable forgings are formed on either the bulldozer or drop hammer, the motors on which handle the work without difficulty. Considerable die work of a large character is done on the large punch and shear.

Outside of the electrical features, as given above, the company has made a beginning in the use of compressed air, using it for small rail hoists, a large overhead traveler for transferring material from narrow gage to full gage cars, and also on a portable power riveter. Besides this they are building a 60-ft. span overhead traveler for the foundry to be operated by compressed air, and are considering the advisability of using this power in place of steam to work the power hammer in the blacksmith shop. Some chipping has also been done with compressed-air tools with considerable satisfaction.

It might be of interest to add that the car shop was recently enlarged to double its former capacity and completely supplied with improved woodworking machinery.

The writer is indebted to the Superintendent, Mr. Fred W. Snow, and the Chief Draughtsman, Mr. Wellington B. Lee, Assoc. M. Am. Soc. C. E., for much of the above information and for attentions while inspecting the shops.



Location of Buildings at the Ramapo Iron Works, Hillburn, New York.

Locomotive Counterbalancing and its Effects.*

BY A. H. ANGIER, *Engineering Staff Chinese Eastern Railway.*

The rational balancing of the moving parts in locomotives is becoming a matter of increasing importance, on account of the constant increase in the weight and power of the locomotive itself, as well as the increase in running speeds.

As a whole the problem is a simple one, and it is perhaps for this very reason that the attention paid to it is so limited, and it is for the sake of substituting rational methods for the arbitrary system in actual use that the author has taken up the question. The rotating and reciprocating masses, as a result of their inertia, produce a series of internal efforts which may amount to a good deal at high speeds.

These effects are universally counteracted by placing in the main driving and coupled wheels heavy masses forming counter-weights, so located that they will produce a series of dynamic effects in an opposite direction to those which they are intended to annul. The rotating masses can thus be balanced without any difficulty, but it is evident (neglecting for the moment the obliquity of the connecting rod) that a revolving counter-weight cannot balance, in the strict sense of the word, the reciprocating parts; it may serve well enough to check their horizontal accelerations, but with the result that they give rise to an undesirable supplementary effect; a variable vertical effort, equal to the vertical component of its centrifugal force, is brought into action, which alternately increases and diminishes the weight of the wheel on the rail. Under certain conditions this counter-weight may even remove all weight from the wheel when it is passing its highest point, and will then double the normal load when at the lowest. This is an extreme case, but it shows itself in the more or less pronounced hammering of the track and the irregular wear of the tires, which are the inherent defects of the system.

The complete neutralization of the acceleration of the reciprocating parts and the avoidance of exaggerated vertical efforts being incompatible with each other, we must have recourse to a compromise which consists in balancing only a portion of the weight of the reciprocating parts, plus all of the revolving parts; for it is evident that the latter play no part in the effects mentioned.

The preceding statements have been made regardless of the obliquity of the connecting rod, as well as the variations in the work done by the steam: these factors cause rolling and galloping at the supplemental loading and unloading of certain pairs of wheels. The importance of these forces varies infinitely according to the construction of the engine and the running conditions, and we merely mention them in order to call attention to the phenomena.

Let us first establish formulæ that are quite elementary, relative to the size and position of the counter-weights corresponding to predetermined conditions; and, to avoid repetitions, let us designate by reciprocating masses the parts that move to and fro, and by rotating masses the parts that have a simple rotary motion.

The parts to be balanced include:

1. The reciprocating masses, such as the pistons, piston rods, crossheads, etc., plus a portion of the connecting rod.

2. The rotating masses, such as the remainder of the connecting rod, the cranks of the main driving and coupled wheels and the side rods. We still make a distinction between the parts belonging to the driving wheels and the coupled wheels by considering each pair separately. To these weights we should add those of the reciprocating and rotating parts of the valve motion, which, however, on account of their slight weight, are usually disregarded.

The centrifugal force of the rotating masses and the accelerations of the reciprocating parts vary in a direct ratio to their weight, and are developed in different planes; an investigation of their conditions of equilibrium reduces it to an equilibrium of a series of normal forces, spaced along the axle of the driving or coupled wheels of the engine.

There are four cases for our consideration:

A. Engine with inside cylinders and wheels free.

B. Engines with inside cylinders and wheels coupled.

C. Engines with outside cylinders and wheels free.

D. Engines with outside cylinders and wheels coupled.

We shall only consider the case of two-cylinder engines, with horizontal cylinders, and will first take up the case of the B type of locomotives.

B.—ENGINE WITH INSIDE CYLINDERS AND WHEELS COUPLED.

We shall consider the case of a four-wheeled coupled engine whose coupling cranks stand 180 deg. from the corresponding driving cranks.

(1) *Driving Wheels.*—For a single cylinder of the engine let:

P_1 = the weight of the reciprocating parts including a portion of the connecting rod;

P_2 = the weight of the rotating parts plus the remainder of the connecting rod;

$P = a P_1 + P_2$, the weight to be considered applied at the driving crank, a being a coefficient < 1;

Q = the weight of the coupling parts (crank, crank pin and one-half of the side rod);

$2K$ = the transverse distance between the center lines of the cylinders;

* Translated from the French as published in the *Revue Generale des Chemins de Fer*, June, 1897.

$2L$ = the transverse distance between the centers of gravity of the counterweights;

$2M$ = the transverse distance between the centers of gravity of the coupling parts taken together (between centers of planes of coupling).

These weights, as well as all others that may enter into the following calculations, are supposed to be reduced to the radius of the driving crank.

We shall consider, for the sake of an example, the left hand side of the engine. Let us indicate as positive all counterweights acting in a direction opposite to that of the driving crank, and as negative all acting in the same direction as this force. Fig. 1 shows the distribution of these forces. The conditions of equilibrium are:

Equation of forces: $R + S = P - Q$.

Equation of moments: $$R = P\frac{L-K}{2L} + Q\frac{M-L}{2L}$$

$$S = P\frac{L+K}{2L} - Q\frac{M+L}{2L}$$

The formulæ give the value, in each driving wheel, of the counterweight corresponding to the left-hand cylinder of the engine. The two counterweights have the positive sign, hence they are diametrically opposite to the left-hand crank.

For the right-hand cylinder, we obtain the same two counterweights R and S, in positions interchanged relatively to the two wheels and fixed 90 deg. from the first in the plane of each wheel (Fig. 3). The two counterweights in each wheel can be replaced by a single one, equal to their resultant in size and direction. The value of this resultant obtained either graphically or by calculation is:

$$C = \sqrt{R^2 + S^2} =$$

$$\frac{1}{2L}\sqrt{2L^2(P-Q)^2 + 2(PK - QM)^2} \qquad (1)$$

Its direction relatively to that of the driving crank prolonged is given by the proportion:

$$tg\,\varphi = \frac{\text{distant counterweight } R}{\text{next counterweight } S}$$

$$= \frac{P(L-K) + Q(M-L)}{P(L+K) - Q(M+L)} \qquad (2)$$

The formulæ 1 and 2 define the size and direction of the final counterweight of the left hand wheel. Everything being symmetrical, it follows that that of the right-hand wheel will be of the same size, and have the same angle of deviation φ, taken in the opposite direction from a prolongation of the driving crank. The positive sign of the value $t\,g\,\varphi$ indicates that the two counterweights (right and left) are located in quadrants opposite to that of the cranks; their axes in the plane of the wheels are evidently $90° - 2\varphi$ apart.

(2) *Coupled Wheels.*—Two cases must be taken into account in considering these wheels, as to whether only the coupling parts belonging to them are balanced or whether a supplemental portion of the reciprocating masses, which act directly upon the driving crank, is added. Let us suppose this latter to be the case; then by the same course of reasoning we shall have: (Figs. 4 to 6)

Equation of forces: $G - H = p - Q$.

Equations of moments:

$$G = -p\frac{L-K}{2L} + Q\frac{M-L}{2L}$$

$$H = -p\frac{L+K}{2L} - Q\frac{M+L}{2L}$$

Final left counterweight:

$$D = \sqrt{G^2 + H^2}$$

$$= \frac{1}{2L}\sqrt{2L^2(p-Q) + 2(pK - QM)^2} \qquad (3)$$

Tangent of the angle of deviation:

$$t\,g\,\mu = \frac{\text{distant counterweight } G}{\text{next counterweight } H}$$

$$= -\frac{p(L-K) + Q(M-L)}{p(L+K) - Q(M+L)} \qquad (4)$$

Q being always greater in practice than p, it follows that the nearby counterweight H as well as the value $t\,g\,\mu$ is negative. An inspection of Fig. 6 will show that this angle is measured from the direction of the coupling crank prolonged (in this case that of the greater weight), and is outside of the opposite quadrant.

The final counterweight of the right wheel is of the same size, and has the same angle of deviation as that on the left; its center stands at an angle of 90 deg. + 2μ from that on the right. For the sake of clearness w have indicated their respective positions in the figures by the lines drawn to them.

We shall not enlarge further upon the case where the coupling cranks are upon the same side of the center as the driving cranks. It is, in fact, sufficient to change the sign of Q in the formulæ used.

A.—ENGINE WITH INSIDE CYLINDERS AND WHEELS FREE.

The formulæ relating to this case are readily deduced from the preceding. As there are no side rods or coupling connections, it suffices to suppress Q in formulæ 1 and 2. The distribution of forces is shown by Fig. 2, and we shall have

$$\text{Final counterweight } C = \frac{P}{2L}\sqrt{2(K+L)} \qquad (5)$$

$$\text{Tangent of angle of deviation } t\,g\,\varphi = \frac{L-K}{L+K} \qquad (6)$$

The angle of deviation being positive, it is taken exactly as in case *B*, and the right and left counterweights are located in the quadrants opposite to the cranks. An inspection of formula 6 shows that the angle of deviation φ depends only upon the location and that it is independent of the absolute weight of the pieces.

D.—ENGINES WITH OUTSIDE CYLINDERS AND WHEELS COUPLED.

Again let:

P_1 = weight of reciprocating parts including a portion of the connecting rod.

P_2 = weight of the remainder of the connecting rod.

$P' = a\,P_1 + P_2$ the weight to be considered as applied at the driving crank.

Q' = the weight of the crank, the crankpin, plus one-half of the side rod.

$2K$ = the transverse distance between cylinder centers.

$2L$ = the transverse distance between the centers of gravity of the counterweight.

$2M$ = the transverse distance between the centers of gravity of the parts Q' of the driving wheels taken together.

$2N$ = the transverse distance between the centers of gravity of the parts Q' of the coupled wheels taken together.

Fig. 7 shows the distribution of the forces.

As all of the masses to be balanced are upon one and the same side of the wheel, the method of applying a rational solution is simpler in this case than in the preceding, and is to determine the transverse distance k between the centers of gravity of the weights $P' + Q' = P$ taken together, for the main driving and coupled wheels respectively. Hence, by following the method already laid down we shall find:

Final counterweight C (driving wheels)

$$= \frac{P}{2L}\sqrt{2(L^2 + k^2)} \qquad (7)$$

$$\text{Tangent of the angle of deviation } t\,g\,\varphi = -\frac{k-L}{k+L} \qquad (8)$$

These formulæ apply to the coupled wheels and also to case *C* of an engine with free drivers, by giving P and k their proper values. The angle of deviation being negative it falls outside the quadrant opposite to the cranks as shown by Fig. 9; the symmetrical position of the right and left counterweight of the same pair of wheels is clearly shown from what precedes.

The formulæ thus established embrace a very simple theory for the calculation of the counterweight, and include the ordinary cases of practice, and it will be easy to deduce others from them which will apply to engines of unequal size, multiple cylinders, or those whose centers are not in the same plane. The final counterweight of an engine can also be obtained by examination and compounding successively the rotative and partial reciprocating counterweights of the wheel, which can only be determined by separating the two types of masses and putting them in the formulæ. Fig. 6, for example, shows this method of doing it; d and e represent respectively the rotative and partial reciprocating counterweights; the angle of deviation of the latter is indicated by the letter ρ in all the figures. The reciprocal decomposition of the final counterweights into partial counterweights is effected with the same facility. The gist of this remark is that the rotating masses and their partial counterweights being in equilibrium in all positions, can be determined by a study of the disturbing forces which come from the reciprocating parts alone.

We shall now pass to the practical side of the question.

ACTUAL COUNTERWEIGHTS.

All of the weights which have been considered up to the present time have been supposed to be reduced to the radius of the driving crank. The center of gravity of the actual counterweight being at a greater distance from the center of the wheel, its actual weight will be proportionally less than the calculated weight. This center of gravity may be obtained by calculation or graphically, but in any case it is well to verify it by a template cut out of sheet metal as shown in Fig. 10. The template is fastened at the end of a balanced bar, and a simple weight gives the elements which permit the desired point to be determined. It may be remarked that calculations which are too minute are valueless, for errors in execution will go beyond the limits of a fraction of a pound. We also add that there is no use, from the standpoint of the intensity of the disturbing forces, in putting the centers of gravity outside the rolling planes of the wheels. The stresses which are invariably calculated from the distance between these planes necessarily remain the same. As for the form of the counterweight, it is scarcely necessary to insist at any great length upon the advantage of having it solid with the wheel center, especially since cast-steel wheel centers have come into general use.* We can only say that the hollow form for the sake of less weight is an advantage, especially as the section can be gradually changed and the stiffness of the rim thus increased. Sudden variations of section are invitations to rupture as well as the cause of shocks.

The use of lead permits the size of the counterweight to be reduced by about 20 per cent., as well as giving an opportunity of easily regulating the weight; but it can evidently have no influence upon the intensity of the vertical disturbances.

DISTRIBUTION OF THE CONNECTING ROD.

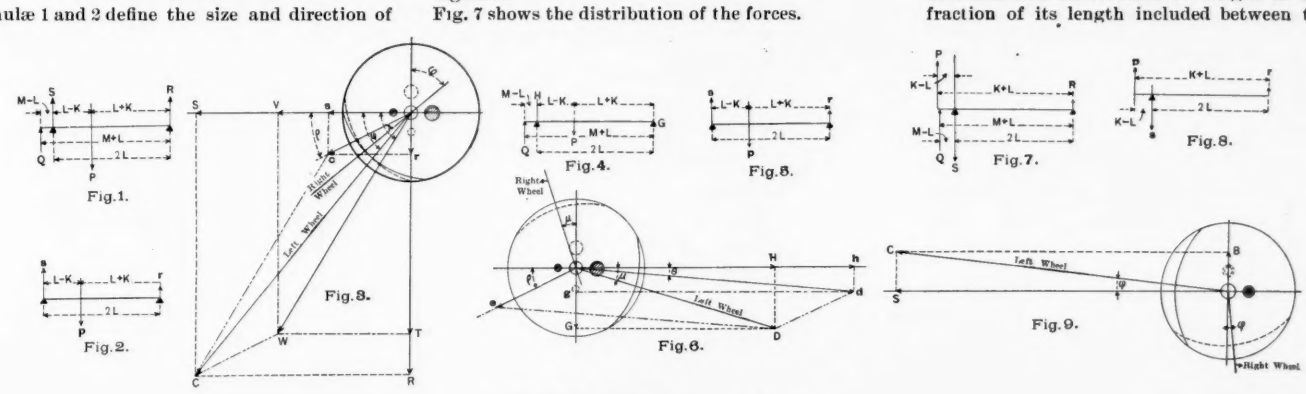
The movement of this piece is of such a composite character that an exact analysis of it is somewhat difficult; it is customary to consider $\frac{6}{10}$ of its weight as belonging to the rotating masses and the remainder to the reciprocating masses. It is evidently an arbitrary method, and it seems to us that it would be better to to substitute the method of Mr. Yarrow, celebrated builder of torpedo-boats at Poplar (London). He determines this distribution of weight as follows: The fraction of its length included between the center of gravity of the whole piece and the center of the crankpin is that portion of its weight that must be reckoned in with the reciprocating parts. From a memorandum that has been kindly furnished to the author by Mr. Webb, the well-known Locomotive Superintendent of the London & North Western Railway, it appears that the following method, which is identical in principle with that of Mr. Yarrow, is used upon that road. The large head of the assembled connecting rod, set exactly horizontal upon knife edges, rests upon the platform of a set of scales; the weight thus obtained is that which is to be considered as belonging to the rotating masses. The piece is turned end for end and weighed again, the horizontal position being carefully maintained, and this gives its reciprocating weight. This is, as we can see, a very simple improvement, and one that allows for the peculiarities of each construction.

LOCATION OF THE COUPLING CRANKS.

On engines with inside cylinders it is possible to place the coupling cranks either in line with the driving cranks or diametrically opposite to them. The second arrangement is generally followed, but some roads, the London, Brighton & South Coast, for example, prefer the former. Its advocates claim in its favor that there is less wear upon the brasses and guard plates, from the fact that the stresses of the connecting and side rods are subtracted from each other instead of being added together, so that there is less pressure upon the wearing surfaces.

On the other hand, it requires a very heavy counterweight, which is often very difficult to place in the wheels; the author has had occasion to note in the London-Brighton shops that the guard plates of the engines so built do not seem to be in any better condition than upon other engines with the customary arrangement. It may be said that accidental causes of seizing, such as poor lubrication, use of cast iron, dust, etc., have more influence upon the wear of the boxes than the simple, specific pressure, alternating though it be, which is put upon the surfaces. It should be added, however, that some

* It should be borne in mind that this was written for European engineers accustomed to use forged centers.—EDITOR.



Angier on Locomotive Counterbalancing.

time ago the London-Brighton abandoned this practice. and they now place their coupling cranks at 180 deg. from the driving cranks.

CONSTRUCTION OF THE MECHANISM.

An examination of the formulæ shows the size of the reciprocating counterweights, and based upon the intensity of the disturbing forces, it varies in a direct ratio with the distance and the weight of the corresponding parts: the best means of cutting down the injurious effects of these forces can be summed up as follows: Cylinders spaced at a minimum distance apart and the reciprocating parts as light as possible; or, in other words, the exclusion of the use of cast iron, avoidance of a great number of parts and attachments and a rational construction, thus realizing as far as possible the forms of equal resistance.

It is upon this point especially that we find some wide differences in practice, as the following table will indicate:

WEIGHT OF PARTS OF THE MECHANISM OF VARIOUS LOCOMOTIVES.

Road.	London & North Western.			London, Brighton & South Coast.	North Eastern.			New York, Lake Erie & Western.
Kind of engine.	Compound express, 3-cylinder.	6 wheels coupled, freight.	8 wheels coupled, freight.	Express, 4 wheels coupled.	Compound express, wheels free.	Express, 4 wheels coupled.	Freight, 6 wheels coupled.	Freight, 4 cylinders, 10 wheels coupled.
Diam. and stroke of pistons.	15 and 30 × 24	17 × 24	19.5 × 24	18 3 × 26	20 and 28 × 24	20 × 26	18 × 24	16 and 27 × 28
Diam. of driving wheels.....	85 in.	50	50	78	91	91	55	50
Kind of crosshead.....	held by 4 guides	held by 2 guides						
Weights.								
a. Piston and rod.....	160 and 442	235	306.5	279	365 and 562	228	234	434 and 946
b. Crosshead.....	159 and 180	71.5	167.5	60	120 and 120	120	223	375
c. Connecting rod.....	343 and 456.5	364	520	408	455 and 455	455	383.5	
Weight of $a + b$ per sq. in. of piston area.....	1.81 and .88	1.35	1.59	1.29	1.54 and 1.11	1.11	1.80	3.09 and 1.98

The American locomotive attracts especial attention by the great weight of its moving parts; this weight is partly an inevitable result of the peculiar arrangement that is characteristic of the Woolf engines of the Vauclain system, but is more particularly due to the fact that American builders strive for cheapness before everything else, and not for a rational design of the several parts. Hence they use massive disks for pistons that are made of cast iron and are very thick, so that the piston rods, connecting rods, etc., are often twice as heavy as need be, if only they would put the several pieces into a proper shape, which could be done by forging and which would enable them to do away with a number of connected pieces with their attachments which now form just so many weak points.

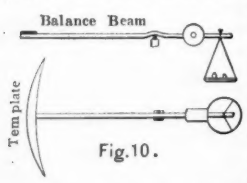


Fig. 10.

By clinging so closely to a low price, the inevitable result is that there is a tremendous stress put upon the track and the rolling stock, defects in American locomotives that are well known;* it should, however, be added that American engineers have at last recognized the importance of lighter parts even at a higher price.

(TO BE CONCLUDED.)

* The *Railroad Gazette* has published many interesting photographs of track injured by badly balanced locomotives.

The Present and Future of the Engineering Schools.

At the Toronto meeting of the Society for the Promotion of Engineering Education, which began on Monday of this week, Dr. Henry T. Eddy, of the University of Minnesota, President of the Society, delivered the opening address and for the short abstract which we make of it, we have chosen the title above. In what follows, we shall quote and paraphrase indiscriminately without the use of quotation marks, but trust that no injustice will be done to Dr. Eddy by this method of treatment. The regulations of the Society permit us to publish papers in advance of their appearance in the volumes of its Transactions only by abstract.

A striking peculiarity of engineering education is that it has been determined so largely as to scope and development by the engineering colleges in advance of the demands of the profession and the public and often in opposition to such demands. The wisdom and foresight of the organizers of engineering education have brought the profession of engineering to rank with the learned professions.

The times in which we are living will be looked back to as those in which mighty educational forces were inaugurated and adapted to the needs of the nation. The triumphs of the engineer in applying steam and electricity are making of one blood all nations of the earth. But the one thing that is making and will make of us a nation worthy of our heritage is our educational life. Our republican institutions, the pride of our early national life, cannot continue such except for the reinforcement and help to come from the enlarged scope of education to-day.

The demand is growing stronger that engineering courses shall include nothing else than engineering; that they shall be completely professional as are the courses in law and medicine. This demand is not made by the general public or generally by practitioners of the profession who are greatly impressed with the necessity for general culture. The demand is made by the engineering colleges themselves. The present curriculum includes 20 to 25 per cent. of culture studies, 30 to 25 per cent. of indirectly technical studies such as mathematics, physics, etc., and 50 per cent. of directly technical studies. The culture studies are of fundamental importance to the engineer, but the student and the instructor both feel that they are out of place in an engineering course, and it seems clear that these studies must soon disappear from the engineering course. Such part of his education the engineer must acquire outside of the engineering course, and preferably before he begins it. The tendency is to insist more strongly than heretofore upon culture studies as essential to the engineer, but in future these will probably be pursued by taking some part, more or less complete, of a regular college course.

The indirectly technical studies, such as mathematics, mechanics, physics, chemistry and drawing, which now occupy from one-fourth to one-third of the average engineering course, have a rightful place in the course; but the question, whether the amount and quality of the work accomplished in these studies is satisfactory, is still open. The standard has been gradually advancing against the opposition of a large number of active practitioners who are largely opposed to teaching more mathematics, etc., than they were taught. The arguments have often met acceptance even with technical professors, but they are fallacious and we are to look upon the gradual advance of the standard in mathematics, etc., as a movement still in progress.

Perhaps the point of greatest difficulty, so far as mathematics is concerned, has been to have the differential and integral calculus so incorporated into the engineering course as to really become part of the working equipment of the student. That may not have been completely accomplished as yet, but that is the standard now regarded as essential, and one which is more and more nearly attained year by year. It is my opinion that it will not be satisfactorily reached until the course in calculus includes the treatment of differential equations. This conclusion is forced upon me, not merely by the abstract consideration that physical and mechanical questions find their expression best by the use of differential equations; but the problems arising just now in the theory of alternating currents must evidently be treated on the basis of their differential equations.

The principles of mechanics underlie all physical phenomena and all engineering processes. Their formal study has been found to be of increasing importance. As to physics and chemistry, I need not explain how small are the opportunities compared with what is desirable, and we must look for an increase in the amount and an improvement in the quality of the work in all that which, although but indirectly technical, affords the theoretical basis of the strictly technical studies in the engineering course. The improvement in the quality of the instruction will be reached partly by improvement along the line of illustrations and problems employed; in seeing to it that these have to do with things tangible and in the direction of practice. This will help to secure the the necessary interest in theory and make it the basis of practice.

Considering the strictly technical parts of the course, it is not the intention to make skilled workmen. Any effort to make prolonged exercises in woodworking, in the machine shop, etc., take the place of theoretical study is an endeavor to make a workman or a foreman instead of an engineer; and this is true of extended field practice with instruments. The plan of putting shop practice, fieldwork and the like into the long vacations seems to be coming more into vogue. The student should graduate from these as soon as he has a moderately good acquaintance with tools and processes and enter the testing laboratory. This is the true field for extended practical work. Only by prolonged drill and testing can the student acquire the necessary basis for judgment which will make his opinion valuable. But while insisting upon the testing laboratories as the best and most important recent development, it is needful to still insist, and with greater emphasis, on the paramount importance of theoretical instruction in the mathematical, mechanical and scientific principles which furnish the core of every engineering course. Engineering colleges may leave out shops and and laboratories; they may omit culture studies and have very imperfect instruction in drawing and design, without forfeiting the claim to give engineering courses of considerable value. But no engineering college can afford to neglect or slight efforts to thoroughly indoctrinate its students in a complete and extended theoretical treatment of engineering subjects.

After all, the fact remains that the ultimate success of the engineer depends upon his character, his force among men, his culture, his integrity, his tact and social powers. Here then is an argument for broad preliminary culture before entering upon engineering studies. But this points further to something with which the engineering colleges have not thus far busied themselves. Every engineering student has the right to careful instruction in a recognized code of professional ethics which shall instruct his conscience and fortify his will and give him a satisfying consciousness of duty done to his professional brethren, to the public and to the Judge of all the earth. It remains for the engineering colleges to help organize the profession and to furnish the basis of organization in a code of professional ethics.

Provision should be made also for instruction in the law of contracts. It is not only necessary that the engineer should have scientific and technical knowledge and have the ability to clearly set forth his plans in a manner to carry conviction, but it is equally necessary that he should be able to clearly and explicitly set forth the rights and obligations of all parties so that disputes and legal difficulties will be avoided.

It has been urged that economic design, as dependent upon the market prices of materials, labor and power, should find a place in the engineering course, but the consensus of best opinion seems to draw the line here between education and practice. The attention of the student should undoubtedly be drawn to the economic limitations under which he must work, but the attempt to make designs under these limitations should be left to the time when judgment has ripened and the conditions of practice are better known.

It will be noticed in all the matters in which I have attempted to reflect the opinions which are current in the papers that have been presented to this Society and published in its proceedings, the movement and tendencies which I have sketched can be traced, all of them, to a single source, namely, to the position of influence and responsibility which the professional engineer has but recently come to occupy. That position is what it is to-day in the esteem and respect of the public largely through the wise efforts of the managers and instructors of the engineering colleges. Their work in molding and directing the engineering education in the future will, I am persuaded, be no less important than in the past. That such guidance shall continue to be wise, the progress healthful and costly mistakes avoided, will be materially assisted by the deliberations and discussions of this Society.

The Efficiency of Technical as Compared with Literary Training.*

We are to consider two processes—technical training and literary training—to determine which gives the highest percentage of useful output for the energy expended. Comparison is a task of great difficulty in the absence of a definite unit by which the output can be measured. To begin with, we are bound to define what is meant by a better-equipped man, more useful man or better-educated man. The whole controversy turns on the meaning of these phrases. If the word "training" be used in the restricted sense, now all but universal, the battle would be won for the technical schools before the first gun is fired. No one will deny that in fitting a man to do specific tasks they are vastly more efficient than the literary schools.

But, not to take advantage of our situation, we will assume the word "training" to mean education in its highest signification and inquire, what is the meaning of education? No better definition exists than the famous description of a liberally educated man given by Huxley: "That man has a liberal education whose body has been so trained in youth that it is the ready servant of his will, and does with ease and pleasure all that, as a mechanism, it is capable of; whose intellect is a clear cold, logic engine, with all its parts of equal strength and in smooth running order, ready, like a steam engine to be turned to any kind of work and to spin the gossamers as well as forge the anchors of the mind; whose mind is stored with the knowledge of the great fundamental truths of nature and of the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions have been trained to come to heel by a vigorous will, the servant of a tender conscience; one who has learned to love all beauty, whether

* A short abstract of a paper by **Dr. T. C. Mendenhall**, President of the Worcester Polytechnic Institute, presented at the Toronto meeting of the Society for the Promotion of Engineering Education.

of nature or of art, to hate all vileness and to esteem others as himself."

But what constitutes a technical and what a literary education? We will take a "type specimen" of a course of study leading to the degree of Bachelor of Arts. This is taken from an institution where electives are allowed from the beginning of the Sophomore year and where there is a tolerably strong leaning toward science and where there is no attempt to show how completely a man may avoid contact with modern scientific thought. Here we find the total energy expended in getting educated distributed as follows:

Literary subjects	67 per cent.
Mathematics	16 per cent.
Science	17 per cent.

Let us take now a type of technical training. Here the distribution is:

Literary subjects	19 per cent.
Mathematics	21 per cent.
Science	60 per cent.

Under science about 18 per cent. should be allowed to pure science and 42 per cent. to applied science and technics. It is worth noting also that the scientific course gives more energy to literary studies than the classical course does to science. It remains now to be considered which of these two schemes is most likely to be effective in producing that liberal education which Huxley has so clearly defined.

In the training of the body perhaps neither the literary nor the scientific institution is highly efficient in spite of the millions invested in gymnasiums, athletic fields, ets., for the use of this money has mostly degenerated into an abuse in specialization and excessive training of the very few to furnish amusement and excitement for the many. For scientific schools it may be claimed that they are much less guilty in this respect, and, further, that a good share of their training in the drawing-room, laboratory, field and workshop helps to make a man's body the ready servant of his will.

Second, as to Huxley's requisite that the intellect should be a clear, cold, logic engine. While no one can doubt the disciplinary effect of language studies, no one can claim that in the cultivation of reasoning powers the power of protracted, serious and productive thought, they are at all comparable with mathematics and science. In the study of mathematics one is trained in pure logic; in the study of science one learns to grasp the great fundamental laws of the entire world, and the fundamental properties of matter. In the application of the logic of mathematics to the facts of science the intellect finds its most exalted and fruitful occupation. The power of clear, clean thought is necessary to the progress of the student of science.

Finally, there remains the development of moral qualities, after all the most important of the educational essentials. In no other kind of discipline is the value of honesty so clearly demonstrated, and no other one so perfectly inculcates respect for the opinions and judgment of others as the training of a man of science.

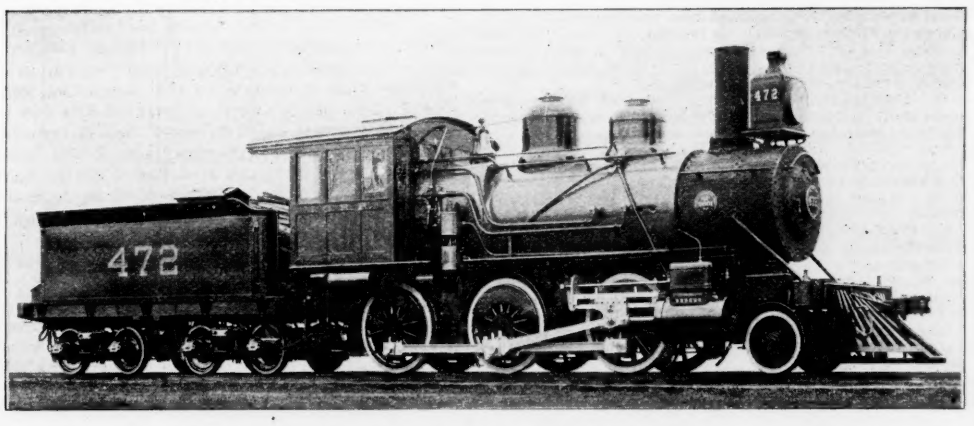
It is urged that classical and literary studies are of first importance because by them man may know man, his nature, disposition and motives; but after some thousands of years of opportunity not much seems to have been accomplished along this line.

It is argued that a knowledge of ancient tongues opens the door to a literature of great beauty and excellence, but it is doubtful if this knowledge is often good enough to open the door wide enough to give more than an unsatisfactory glimpse, and there are many excellent translations made by competent experts. The study of ancient languages is believed by many to be necessary to an easy, accurate and graceful use of our own tongue. To some degree this is true, but a thinking man is a higher product than a talking man, and the people whose linguistic power in essay and oration most commanded our admiration knew no language but their own.

It is not contended that the training afforded by even the best of our scientific and technical schools is perfect, or even approximately so. Our contention is only that when two courses of study are contrasted, the one assigning two-thirds of the energy expended to language studies, the other about the same proportion to science and its application through which the forces and materials of nature are made tributary to the comfort and happiness of man, the latter may well claim a higher percentage of efficiency, even if the useful product is restricted to what is called a "liberal education," for as Priestly said a hundred years ago, "by these sciences also it is, that the views of the human mind itself are enlarged, and our common nature improved and ennobled.

Mogul Locomotives for the Illinois Central.

The Illinois Central recently placed an order with the Brooks Locomotive Works for 10 standard mogul freight engines, five of which were delivered in July and the remainder are to be delivered in September. One of these engines is shown by the accompanying engraving.



Brooks Mogul for the Illinois Central.

The cylinders are 19 in. × 26 in.: diameter of driving wheels, 56½ in.; diameter of engine truck wheels, 33 in., and the total weight in working order is 126,400 lbs. The boiler is of the Belpaire type, of Otis steel, to carry a pressure of 180 lbs. per square inch. The thickness of the material in the cylinder courses and wagon top is $\frac{9}{16}$ in., side sheets, $\frac{7}{16}$ in.; throat sheet, $\frac{5}{8}$ in.; back head. $\frac{9}{16}$, and in the front flue sheet, ½ in. The outside diameter of the smallest ring of the barrel is 62 in. There are 1,358 sq. ft. of heating surface in the tubes, and 162 sq. ft. in the firebox, making a total heating surface of 1,520 sq. ft. The grate surface is 26.4 sq. ft. There are 236 tubes, 2 in. in diameter, and 11 ft. 2 in. long, of No. 12 W. G. charcoal iron.

The firebox is of Otis steel, of the long sloping type, 115 in. long, 34 in. wide, 68 in. deep at the front and 60 in. deep at the back, with a brick arch carried on studs. The firebox flue sheet is $\frac{9}{16}$ in. thick, crownsheet ⅜ in., and the side and door sheets are $\frac{5}{16}$ in. thick. The fuel used is bituminous coal.

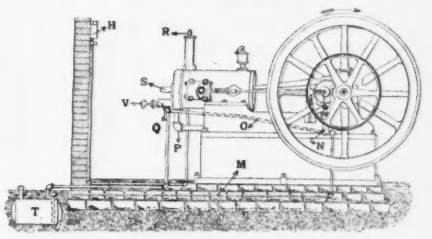
The tender has an oak frame, a water capacity of 3,850 gals., and a coal capacity of about seven tons.

The driving wheel centers are of cast iron, made by the Brooks Locomotive Works, the engine truck wheels are of the Paige plate pattern, with steel tires, and the tender wheels are cast iron, furnished by the New York Car Wheel Co., Krupp open-hearth steel tires are used. The air-brake equipment for the locomotives was furnished by the American Brake Co., and the tender brake equipment, air pumps and governors by the Westinghouse Air-Brake Co. Player brakebeams are used on five tenders and monarch beams on five. Magnesia sectional lagging is used for boiler coverings and Damascus bronze is used throughout for bearings. Ashton safety valves, mufflers and gages, and Nathan lubricators are used on all the engines. For one-half the engines Monitor injectors were furnished by the Nathan Mfg. Co., and for the remaining engines Ohio injectors are used. Thurmond couplers are used both in front and at the rear. All the engines are fitted with Nutting smoke burners and Barnes cast-iron whistles, while four are fitted with Smith exhaust pipes. The piston and valve packing was furnished by the United States Metallic Packing Co., and the springs by the A. French Spring Co.

The Fairbanks-Morse Gas and Gasoline Engines.

Many who have carefully studied the gas-engine problem have been led to believe that the industry will grow rapidly as the objections to the adoption of this class of engines are removed. The actual fuel economy of the internal combustion engines over the steam engines when the two are worked under the same conditions, and with fuel at the market price, has unquestionably been confirmed as the results of many tests. In following along the line of the development that has been made, it will probably be of value to examine carefully the construction and operation of standard types of engines. To this end we present some of the essential features of the engine made by Fairbanks, Morse & Co., under the direction of Mr. James Charter, of Beloit, Wis.

In the gasoline engine here illustrated the oil is drawn from the tank *T* by a small pump *N* through the pipe *M*, and delivered to a reservoir *Q*, attached to the cylinder head of the engine. Connected to the inner face of the reservoir and extending into the air port in the cylinder head is a tube or nozzle, the end of which is carried to a height sufficient to prevent any overflow or discharge of oil from the reservoir into the air suction or port in the cylinder head. An automatic valve, *S*, is placed in the cylinder head just above the end of the tube or nozzle for delivering the gasoline. This valve is automatic, being drawn to its seat by a spring. The head is water-jacketed for protecting the valve, so that on the suction or inhalation stroke of the engine the air that is drawn through the port in the cylinder head



The Fairbanks-Morse Gasoline Engine.

tends to produce a vacuum in the port which surrounds the tube or nozzle attached to the above-described reservoir *Q*. This suction action of the in-going air lifts a small amount of the gasoline that is in the tube and sufficient oil is thus drawn out in a fine spray or suspended vapor and carried with the air into the cylinder where it is retained by the automatic suction valve to form an explosive mixture. *H* is the tank for the fuel which supplies the Bunsen burner, the oil passing to the ignitor tube *R* through the pipe shown in the figure. The engine is governed by holding the exhaust valve in an open position and at the same time a special rocking shaft conveniently attached to the exhaust rod retains the suction valve, positively to its seat, preventing any possible in-take of air to the suction valve. By holding the exhaust open, as is done in governing, the engine is relieved of all back pressure and friction due to compression which would otherwise occur when the engine was governed by cutting off explosion, and was allowed to draw in air and compress it as does the Otto and nearly all other types of four-cycle engines.

One of the drawbacks to the success of the gas engine has been due to the inability to start it under load. In the Fairbanks-Morse engine, however, a detonator is used, by means of which a saturated mixture of air and gasoline is forced into the cylinder under a pressure, the engine being placed on the explosive stroke, and by a few strokes of the pump sufficient compression is obtained to enable the engine to move. After it has been started the auxiliary firing device is used, exploding the mixture pumped into the cylinder. The power obtained from this explosion is sufficient to start the engine under at least half the load it is able to operate. The auxiliary firing device enables the operator to ignite the charge at any desired point on the stroke. Should the first attempt to start the engine under a partial load be a failure, it takes but an instant to recharge the cylinder and explode the gas. The starter can be operated by almost any one without being especially skilled in its use or handling. There can be no accident or explosion, as an automatic check valve prevents the possibility of the explosive mixture flowing back to the pump. The charge exploded in the cylinder furnished from the hand starter pump is sufficient to give the engine from three to six revolutions, so that there is sufficient speed to draw in a mixture of gasoline and air through the regular supply channel on the next revolution following the explosion of the starting charge, which, in turn, is compressed and ignited by either the tube or electric igniter. For larger engines a more elaborate form of pump operated by hand-wheel and crank is attached, so that the large volume of mixture for large powers is quickly supplied, a few strokes being sufficient to charge a cylinder of a 50 or 75-H. P. engine.

In order to convert the gasoline engine into a gas engine it is simply necessary to place an extra valve under the cylinder with mechanical connections for opening the same at the proper time to admit the gas to the air cushion.

Some of the applications of this gas engine may be mentioned. For pumping purposes the demand has been such that the company is making a specially designed combined engine and pump. In this class of work the economy of the gas engine should be apparent, for in pumping stations the full capacity of the engines is seldom used constantly, while in very many stations the engines are in operation for but a comparatively short time each day. It is necessary, of course, in these cases to keep a fire under the boilers at all times in order to run the engines the short time required where the steam pumps are used. This has been especially true in the case of supplying railroad tanks, and in order to meet the requirements of the case the company are making a special engine and pump. Another use to which engines have been applied is in operating drawbridges. Here again the power is used but a fraction of the time, and with the gas engine the power can be used as developed, it being unnecessay to keep any machinery in motion except at the time of moving the bridge.

During the last six months a Fairbanks-Morse 25-H. P. gasoline hoisting engine has been in use at the mines of the Southern Eureka Leasing Co., at Robinson, Utah. At present the shaft is 300 ft. in depth and the engine averages a hoist of 26 buckets of rock each day, the combined weight of the bucket and load being nearly 1,200 lbs. It requires from 45 to 50 seconds to hoist a load

and the round trip can usually be made in 1¼ minutes. The cost of gasoline at the mine has averaged 19 cents a gallon and the gasoline consumption has been but $\frac{7}{10}$ of a gallon each hour, thus making the cost of fuel a little over 13 cents an hour. The operator is stationed near the shaft and starts the engine by means of the automatic starting device referred to in the above description. The operator also wheels away and dumps the output of the mine. Immediately on ceasing opertions all fuel expenses stop.

A Course of Study in Electrical Engineering.

At the Toronto meeting of the Society for the Promotion of Engineering Education, Prof. R. B. Owens, of the University of Nebraska, presented a paper under this title, of which we make a short abstract. His object is to call attention to the difficulty of keeping instruction abreast of development and to point out some expedients useful in this direction as applied in a school distant from the great industrial centers. The task of keeping school-work up to the best engineering practice seems almost hopeless, so rapid is the development of the art; but such correspondence between instruction and actual practice is of the greatest importance to the student.

It is contended by some that the school should only impart the broad principles that underlie engineering in general and its several branches in particular, but a careful study of the possibilities of technical training shows that much time now spent in learning to apply the general principles might be saved if in the last year or two of study the student is brought closer to the manufacturer and the constructing engineer.

It is generally known outside of the schools that little information of real value relating, for instance, to dynamo design is obtainable in the greater number of courses in electrical engineering in this country. If close relations between the school and practice do not exist, it is the fault of the college-man, who should work as hard during his vacations in collecting material for the coming season's lectures as he does during the period for conducting classes. In engaging an instructor in technology it should be understood that it is a part of his duty to keep close relations between college work and outside practice and a limited consulting practice should be encouraged.

I have adopted the following practice in teaching dynamo design. First, the student is drilled in the theory of electro-magnetism and the magnetic circuit and is then required to fill out in detail the same data sheets that are used by our best manufacturing firms for a number of machines of which working drawings are available. I find this especially useful in giving the student an idea of the proportions which do or have obtained between the parts of single machines. Next curves and tables are made showing the variations in the principal proportions of machines of different types and sizes. This gives the student an idea of the change in particular proportion with conditions of service and output. Necessarily the data possessed by a technical school is not of the latest, but supplementing it by the information secured each summer, a very close approximation to correct practice is obtained. Having worked over all the material available the present tendencies in dynamo design are pointed out as well as can be and explanations given. Then a line of machines for certain assumed conditions is decided upon and each student takes one machine. The work after this is largely at the drawing board. The advantage of having all students working on machines of the same type but of different dimensions is that by comparing notes they are able to see clearly the necessary change in dimensions as the output, etc., of the machines vary.

A line of standard D. C. and A. C. machines are always required, and special machines if time allows. All drawings are made uniform and complete data sheets filled out for each machine. Next the data and drawings are submitted for criticism to some one whose business it is to design machines, to maintain the reputation of and earn an income for those who invest their money in the manufacture of electrical machinery. In this way it is attempted to give the student salable information without sacraficing principles to unnecessary detail.

Lectures on electrical lighting, street railroads and general installation work are supplemented by a required design of a lighting or railway plant. A number of scale drawings of towns of various sizes are available, and from known or assumed conditions the station is located. Then if it is a lighting plant the location of individual consumers is assumed with particular load diagrams for each. From the individual load diagrams the nature of the station load is determined and the machinery and circuits laid out. All circuits are calculated and shown on the map, together with poles and important accessories. Setting plans for standard machinery are readily obtainable, and the station arranged accordingly. This is, of course, the ordinary preliminary survey of the consulting engineer. Next, full specifications for the plant are drawn, definite as regards results to be obtained, but impartial as regards standard apparatus. Well-drawn sets of similar specifications are, of course, available to the student and criticised for his benefit.

Lastly, a bill of material is made and costs worked out for some one type of standard machinery from price lists and labor estimates and the cost of operation and maintenance and necessary income determined to make the plant a paying investment.

Such station plans and estimates are then checked by a constructing engineer whose routine work keeps him directly in touch with such matters.

The tendency to carry system to an extreme in some engineering laboratories is greatly to the student's disadvantage. The best results are obtained by turning over to a group of students a dynamo with necessary testing apparatus and letting them work out results unaided as far as possible. Care must be taken to point out the tests that have commercial value. As new machines come on the market, they should be borrowed, tested and returned, giving new apparatus for investment without developing the laboratory into a junk shop.

Thesis requirement is very valuable for under-graduate work. Valuable data are obtained and the students learn to assume responsibility. Another important expedient is to have specialists give courses of lectures, not isolated lectures, but co-ordinated courses. On these the student should be examined.

To give a full engineering degree for the ordinary four years of college work is unwarranted. The recent graduate is not an engineer; we only hope that he has the capacity to become one. A safer course (adopted at the University of Nebraska) is to require certain additional or graduate work after the bachelor's degree and a full degree is conferred at any subsequent time. If such a practice were general, the degree would have more attention than it has now.

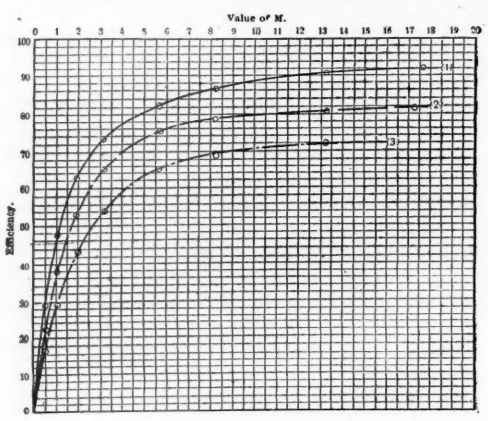
Efforts should be made to raise entrance requirements. This will be effective finally in bringing the special branches of engineering into our graduate schools along with their strictly professional work.

Tests to Determine the Efficiency of Bicycles.*

In the present article the total efficiency of the bicycle will be treated, together with the experimental results on the efficiency of sproket wheels of different size. In these experiments, a method has been adopted which places the bicycle as nearly as possible under riding conditions. The apparatus consists of a 10-in. I-beam planed smooth on top and adjusted perfectly level, a rectangular frame, a pulley, weights and scales.

The handle bar is firmly secured so that both wheels shall be in the same plane and the bicycle mounted upon the beam with the frame attached to the seat part. This frame is bound to the rear forks and extends below the beam, having a shelf attached to its lower end, extending in a direction at right angles to the beam a distance of 36 in. A load of 150 lbs. is placed upon this shelf. Attached to each end of the rear axle is a wire, these wires being fastened to the ends of a yoke, from the center of which a horizontal steel music wire runs over a pulley and carries weight, *M*. The pulley has its efficiency determined for different weights, and a curve plotted, from which the pull on the wire necessary to raise a known weight, *M*, which may be read directly.

One of the cranks is set about 10 deg. above the forward horizontal position, and a scale pan suspended from the middle of its pedal. For a distance of nearly 10 deg. on each side of the horizontal position of the crank its effective radius does not vary one per cent. and may be considered as constant during that period of rotation.



Efficiency Tests of Bicycles

The bicycle has now being transformed into a hoisting machine for raising the known weight, *M*, by a weight applied to the pedal, and the method of testing is that commonly employed in testing the efficiency of pulley blocks, which admits of accurate measurement of the different quantities entering the experiment. A weight of 15 lbs. for the value of *M* may be roughly taken as representing the effort required to propel a rider weighing 150 lbs. up a grade of one foot in 12.

The total efficiency of the bicycle may now be determined as follows: *A* = circumference of tire, *B* = circumference of center of pedal pin, *R* = ratio of large to small sprocket, *P* = weight on pedal, *M* = weight on wire, divided by efficiency of pulley.

$$\text{Total efficiency} = \frac{M\,R\,A}{B\,P}.$$

Results for each wheel are plotted in the accompanying diagram, giving a curve in which the ordinates represent per cent. efficiency, and the abscissas the gross weight raised at the corresponding efficiency.

The efficiency curve for bicycle No. 1 is shown by the full line (1). The bicycle was of the 1897 model, having ground bearings, and representing the best practice in bicycle construction.

Bicycle No. 2 was a medium grade wheel, and its efficiency is shown in the curve (2).

Bicycle No. 3, the curve of which is shown by the dot and dash line (3), was purposely selected as being a cheaply constructed wheel, having, in fact, nothing but its low price to recommend it.

These three curves represent the efficiency of the three bicycles by a method which, it is believed, when carefully applied, will give results of the greatest precision and definitely indicate the comparative efficiency of bicycles under the conditions found in actual service.

Size of Sprockets.—In determining the comparative efficiency of sprockets of different size, the bicycle was inverted, and the frame securely attached to the floor. A method similar to that employed in determining total efficiency was used. A thin steel band had one end attached to the tire, and the other end carrying a weight which which was raised by the band being wound upon the tire, a second weight being hung from a scale pan attached to the pedal as in the preceding experiment, whence the efficiency of the portion of the mechanism transmitting the power can be calculated as before.

A long series of readings were taken with the same large sprocket with seven, eight and nine tooth sprockets on the rear, and with pedal weights varying from two to 50 lbs. The average efficiencies in each case were as follows:

7-tooth	89.9
8-tooth	91.5
9-tooth	93.4

This shows the 8-tooth to have 98.9 per. cent. of the efficiency of the 9-tooth, and the 7-tooth to have 96 per cent. of the efficiency of the 9-tooth sprocket, other conditions being equal.

In actual service, however, the largest rear sprocket which the required gear ratio will allow, is to be preferred, from its better wearing qualities due to the smaller chain pressure upon the teeth.

*From a paper by Mr. J. G. D. Mack, presented at the Hartford meeting of the A. S. M. E., June 25-28, 1897, and included among th e typical discussions.

Electricity from "Dust."

It is a pity that Dickens could not have lived to see the glorious end of Mr. Boffin's dust-heaps, which are now a source of light, heat and power in Shoreditch, a parliamentary borough of London north of the Thames. By "dust" we must understand to be that part of the house refuse which cannot be classed as garbage. Probably there is no one simple name for it in the United States.

The method of utilizing this refuse is simple, and the plan has worked well and attracted widespread attention. Shoreditch, which has a population of about 124,000, produces daily from 50 to 60 tons of dust, and the cost of removing this was formerly 3s. 2d. a ton. Now the dust is brought to the generating station, dumped into bins by electrically worked lifts and cars, from which it is shoveled by hand into 12 furnaces or dust destructor cells, as they are termed, and here the refuse is burned by means of a forced draft. Each of these cells has a heating surface of 25 sq. ft., and the water-tube boilers, six of which are now in service, have each 1,300 sq. ft. of heating surface.

The steam produced drives an engine which in turn drives three high-tension electric generators, besides three dynamos, delivering the current at 165 volts. The dust is burned both day and night, a part of the heat in the day time being stored by heating the feed water by the Druitt-Halpin thermal storage system. The electric lighting station supplies current for the arc lamps which now light the streets of Shoreditch. At midnight these are automatically switched off and incandescent lamps are used until morning. The station also lights and heats the baths and the technical school, ventilates the sewers and supplies cheap electric motive power to families and small shops. Besides this, the houses of the workmen are being fitted with the Bastian penny-in-the-slot meters, whereby the consumer can have an 8-c. p. light for six hours for one penny. In describing the plant *The Nation* states that the machines are now worked up to their limit and new machinery is building. The vestry clerk of the borough calculates that this dust, which was formerly an expensive nuisance, now results in an annual economy of $7,500 to the borough.

Merchants' Despatch Car Shops.

The Merchants' Despatch Transportation Co. is now building at Despatch, N. Y., seven miles east of Rochester, a large car shop plant, consisting of six buildings. The planing mill, power house, blacksmith shop and machine shop are shown in the drawing herewith. At the right of these is the car shed, 302 ft. long by 170 ft. wide, with capacity for 48 cars. This shed stands about 140 ft. from the buildings shown in the drawings, and between these and the shed is the transfer table. Six tracks run from the shops to the transfer table, as shown, and from the other side of the table 12 tracks extend through the car shed. Eight of these are working tracks and four are for delivering material. The car shed will have compressed air jacks for raising and lowering cars and will have Player's apparatus for pulling down sills from old cars by means of compressed air.

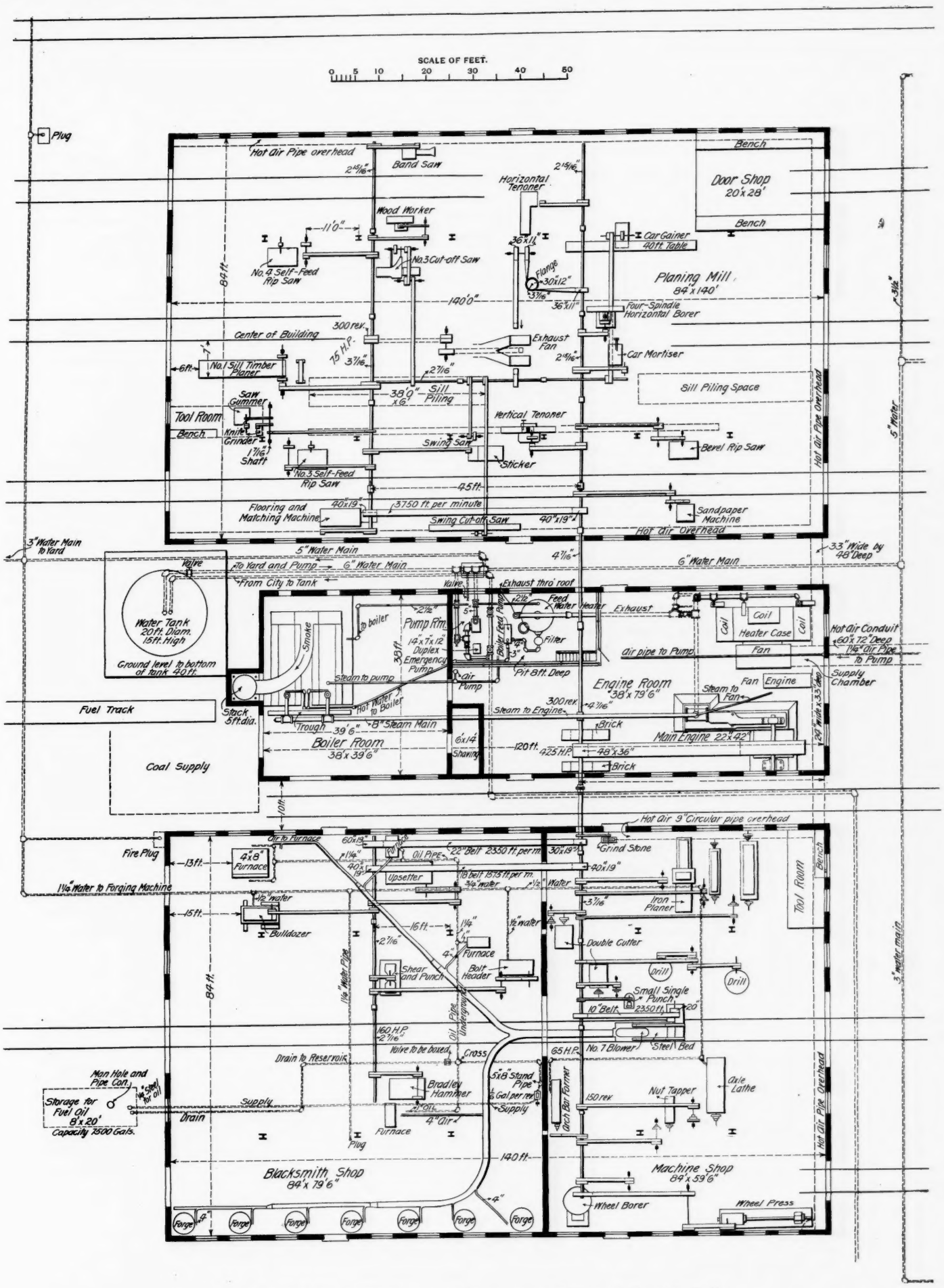
All the buildings have ample openings for ventilation in hot weather, and all, except the office, will be heated with hot air from the engine-room. The engine, Corliss, will be 22 in. × 40 in. with a driving wheel 16 ft. in diameter and 36 in. face. There will be two high pressure boilers of 200 H. P. each. There will be a water tank 40 ft. high with a capacity of 50,000 gallons, and there will be a pump to increase the pressure in case of fire. The water pipes shown in the drawing extend to the other buildings, and all of the buildings and grounds have suitable sewerage, connected with the sewers of the city.

The office, which is 40 ft. × 50 ft., three stories high, stands at the south of the main buildings, near the tracks of the New York Central & Hudson River road. The passenger station is on the opposite or south side of the tracks, and an under passage will be built from the shops to the station. The office will be heated by steam

and each room will have a fireplace, a vault, a toilet room and all suitable conveniences.

The blacksmith shop will be fitted for the use of oil as fuel. The principal machines, as shown in the drawings, are a bulldozer, a Bradley hammer, a shear and punch, an upsetter, a bolt header, an arch bar former, a wheel borer, two double cutters, a nut tapper, a small single punch, an axle lathe, an iron planer, a wheel press, a No. 1 sill timber planer, a No. 4 self-feed rip saw, a flooring and matching machine, a No. 3 self-feed rip saw, a swing cut-off saw, a vertical tenoner, a horizontal tenoner, a car mortiser, a four-spindle horizontal borer, a sandpapering machine, a bevel rip saw and a car gainer.

Besides the buildings mentioned there is a general supply building 42 ft. × 242 ft. north of the car shed. All of the buildings are now under roof.



Car Shops of the Merchants' Despatch Transportation Company at Despatch, N. Y.

Foreign Railroad Notes.

The Directors of the London, Chatham & Dover make the somewhat surprising statement that the Queen's Jubilee had an unfavorable effect on the earnings of the road. The number of persons who would have traveled many of them long distances, but who stayed in London, reduced the general passenger receipts of the company and the money received from the short-trip passengers attending the Jubilee was not sufficient to offset the loss.

The American practice of checking baggage was introduced "experimentally" on the Altona-Hamburg & Berlin line of the Prussian State railroads some years ago, and later on some other Prussian lines. It is now to be tried on some of the most traveled routes of the Saxon State railroads. The rapidity with which the baggage is disposed of in this way is what chiefly recommends it in Germany, where the weighing, registering and labeling of the national method require much handling by employees and infinite patience from the passengers.

The St. Paul's New Eastward Record.

The American Line steamship St. Paul arrived at Southampton Aug. 11 after a passage from New York of 6 days, 13 hours and 27 minutes, about one hour less than her best previous time, made in December, 1895. The record for the eastern trip is held by the Hamburg-American Line steamship Fuerst Bismarck, which made the trip in September, 1893, in 6 days, 10 hours and 55 minutes. The St. Paul holds the westward record of 6 days and 31 minutes, made in August of last year.

RAILROAD GAZETTE

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EDITORIAL ANNOUNCEMENTS.

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting, and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

The Merchants' Association of New York is growing so fast that it can hardly keep tally of its own prosperity. The first buyers' excursion has arrived and the numbers are reported by the thousands. The estimated amount of probable purchases by these buyers varies from $2,000,000 to $50,000,000, but as all estimates include sales to firms which are not new customers it is hardly worth while at the present writing to try to sift out the true facts. There is no question, however, that many Western and Southern merchants have come to New York who under ordinary circumstances would have waited to be called on by drummers. The extremely low rates on freight to Texas have come just at the right time to draw buyers from that state to New York. The Association announces that it will take a hand at freight rates, which means presumably that it will establish a permanent bureau for the adjustment of overcharges and other grievances against railroads. On Tuesday last the Erie road gave a harbor excursion to a party of visiting merchants. Whatever the success of New York may be, it can hardly be said that she has worked any injustice against other cities, for all the other cities seem to be having the same kind of excursions. In addition to those heretofore named, New Orleans, St. Louis, Omaha, Dubuque, Richmond and Syracuse seem to be looking out for themselves with all necessary enterprise. Philadelphia has secured stop-over privileges on excursion tickets from west of Pittsburgh to Atlantic City and Cape May and claims to have had 6,000 arrivals in one day; and the wholesale merchants had to give up their Saturday half-holiday in order to attend to the business. The newspapers there, instead of filling columns with the gushing statements of the local merchants as to how happy they feel, take the more business-like course of printing solid facts to sustain Philadelphia's claim to the position of the greatest manufacturing city in the world. The circular sent out to buyers by the Trades' League was of this practical character. The Boston merchants have been somewhat hampered by the refusal of the New York, New Haven & Hartford to join the other roads in the desired reduction of fare. At Dubuque the merchants propose not only to get reduced fares for buyers, but also to entertain them free while they are there.

Recent Statistics of Exports.

The July report of the United States Bureau of Statistics shows the total value of exports of certain domestic products for the first seven months of 1897 to have been $320,987,075, an increase of 3.6 per cent. over 1896 and 15 per cent. over 1895. These figures include breadstuffs, cotton, mineral oils and provisions.

The exports of breadstuffs in those seven months amounted to 98¾ million dollars, an increase of 19 per cent. as compared with 1896 and 53 per cent. from 1895. Cotton, which amounted in value to about 92 million dollars, decreased slightly. Mineral oils, which amounted to 33¾ millions, decreased from 1896, but increased 14 per cent. over 1895. The exports of provisions, including cattle and hogs, were a little more than in 1896 or 1895, but materially less than in 1894, the sums being $96\frac{4}{10}$ million dollars in 1897, $94\frac{8}{10}$ in 1896, $89\frac{8}{10}$ in 1895, and $106\frac{8}{10}$ in 1894.

The summary for the 12 months ending with June 30, was issued two or three weeks ago and in that we find some very interesting and important figures. We will first give certain exports which, while of quite insignificant amount as compared with the grand total, attract great public attention, more now possibly than ever before. For instance, the exports of locomotives for the 12 months amounted in value to $3,226,000; in 1896 this value was $2,512,000. The gain, it will be observed, was 28 per cent. We judge that this item will be still greater in the current year. The total value of machinery exported was nearly 29½ million dollars in 1897; in 1896 it was $21\frac{2}{3}$ million dollars, a gain of more than one-third. The exports of steel rails in the last year amounted to $2,482,000, and the year before they were only $541,000. Of course it is easy to exaggerate the importance of these sales, but they are very important to a few men and have a public interest far beyond their financial importance. The exports of car wheels amounted to only about $112,000 in 1897 and $104,000 in 1896. These, we believe, are almost entirely street car wheels. The exports of car, passenger and freight, fell off slightly having been $991,000 in 1897 and $1,003,000 in 1896. A very interesting item is that of cycles and their parts, the value of which amounted in 1897 to $7,000,000. In 1896 it was a little less than $1,900,000—a very handsome increase indeed.

After cotton, the greatest single item of export is breadstuffs. In 1896 the value of these amounted to $197,857,000; the year before this value had been $141,357,000, an increase of almost 40 per cent. and it seems quite possible that the exports for the next fiscal year will increase in even greater ratio than they did in the last year.

The exports of mineral oil in 1897 amounted to $56,287,000, almost exactly the value of the 1896 exports. The value of the cotton exported was $230,891,000 in 1897, and $190,056,000 in 1896, and of provisions, $137,138,000 and $131,504,000 respectively.

The total value of exports of domestic merchandise for the 12 months reported on was $1,050,987,000, the increase over the previous year having been 19 per cent. Of all this the United Kingdom took $483 265,000 worth, and the United Kingdom and British possessions took $593,400,000 of it, or 56.4 per cent. of our total exports. Russia took only $8,016,000 worth and South America took but $33,768,000 worth. That is, the United Kingdom and the British possessions took of our surplus product last year 17½ times as much as South America; 14 times as much as South America and Russia together, and 5½ times as much as South America, Mexico, Russia, Asia, Africa and Oceanica (leaving out the British possessions). When we are looking about for means to increase our foreign trade it is well to bear in mind the fact that a gain of one per cent. in our sales to our kinsmen would be equal in amount to a gain of 74 per cent. in our sales to Russia, 17 per cent. in our sales to South America and 50 per cent. in our sales to China. Obviously, the business man must work along the lines of least resistance or he must fail, for some one else will inevitably find those lines. One would suppose that the same policy would be good for a business nation. That being granted, it seems fair to assume that it is easier to add one per cent. to our British trade, where all the great machinery of trade already exists, than 74 per cent., or 50 per cent., or 17 per cent. to our trade with much poorer and much less civilized countries.

The Education of the Engineer.

In Dr. Eddy's discussion of engineering education, which appears on another page, one very important topic is brought up, namely, the place of culture studies in the curriculum. His opinion is that these are of great importance, but that there is not time or place for them in the four years' engineering course. We judge that in this opinion the mass of well-informed instructors and practitioners will agree with him. The amount of knowledge that the modern engineering student must acquire, the amount and quality of the intellectual drill that he must endure to fit him for eminence in one of the most versatile, comprehensive and highly technical of the professions, are so great that four years have come to be too short a time to fairly cover the ground of school preparation. On the other hand, the best is to be got out of a man in any profession and as a citizen of the Republic only by giving him that comprehensive grasp of the efforts and achievements and failures of mankind, that knowledge of human manners and motives in all ages and countries, which we may, for shortness, call a "broad culture." This is not a mere matter of giving him polish; it comes down to giving him varied resources and sound judgment, for, other things being equal, the accomplished man of the world will have safer judgment than the man of narrower opportunities. Probably the saddest mistakes made by General Grant as President, and afterward in civil life, would never have been made if the conditions of his youth and early manhood had given him a broader and more correct perspective. Probably the greatest danger of the Republic to-day is in our active-minded, keen, self-sufficient, American-born population who think that human history began in 1776 and that new and adequate schemes of society can be "thought out" on the top rail of a Kansas fence. But, on the other side, it is hard to find a more narrow-minded, conceited and useless man than one who has followed culture for the sake of cultivating himself. Whole communities have been corrupted by the notion that it is a praiseworthy and improving thing to read thirteen big octavo volumes of Dr. Anderson's British Poets through from cover to cover, or to read a dozen volumes of French "théatre de campagne"; in fact nine-tenths of such reading is a waste of time. After all, culture is effective only in so far as it leads a man to select instinctively that which is refined and gentle and wise and noble, and no college course, short or long, can be so devised that it will automatically and mechanically give much of such effective culture. This is mostly a matter of the personal influence of the teachers. We suspect that the great advance of the future will be made in the quality of the teaching and the kind of teachers, beginning eight or ten years before the boy goes to college, and above all, in the training that he gets in his own home. By and by he will go up to the professional school with such preliminary education that his work there can be strictly professional, and perhaps the best way to hasten that end is to crowd up the entrance requirements, which seem already too hard for the average boy.

We are much interested in what Dr. Eddy says about teaching mathematics. "Perhaps the point of greatest difficulty, so far as mathematics is concerned, has been to have the differential and integral calculus so incorporated in the engineering course as to really become part of the working equipment of the student." It has long seemed to us that either not enough or too much mathematics is taught in the technical schools. The boys are taken over more ground than they can master and not made proficient in any one branch of mathematics. We have often asked professors in engineering schools how many of their graduates come out with such command of the calculus that they can use it in independent and original work? One man says about two per cent.; another man says that this is probably an over-estimate. In fact little mathematics is really needed for the ordinary, or even the highest, work of an engineer. The engineer's mistakes are not often in mathematical technique, but in reasoning. If a man is made proficient in arithmetic, algebra, chemistry, trigonometry and logarithms, with a fair conception of analytical geometry, he has perhaps not so much mathematics as most of the graduates of the technical schools think they have on commencement day, but he has much more than most of them actually possess. If he is taught to reason acutely and profoundly, to brood over his problem until he has exhausted its possibilities, then, indeed, he has a mental equipment far beyond what most practicing engineers ever acquire until the hard lessons of life compel them to become masters of such mathematics as they happen to have—breed in them the energy to reason, and give them confidence in their own mental power. But, after all, this is only a partial statement. The reasonably educated engineer ought to have enough calculus to be able to read any book worth reading, even if he has not enough to make independent use of it in his investigations. And, further, every one admits that a command of the calculus makes analyses possible which without it would be impossible and many others easy, which without it would be difficult. If, therefore, the educators can see how to give our boys actual working command of the calculus, or of quaternions if they wish, without sacrificing physics, mechanics, chemistry and the strictly technical studies, by all means let them do so. But perhaps it would be well for them always to keep in mind a hint which we discover in Dr. Mendenhall's paper—that something should be done for *every* man instead of concentrating the entire educational force on a handful of selected men. We judge that it will be several generations before the average student will have intellectual ability to carry him as far in mathematics as the devoted and enthusiastic teacher thinks he ought to go.

We cannot agree with Dr. Eddy, however, that

the engineering colleges should unite to formulate and teach a code of professional ethics. We have long held that no code of ethics can be formulated that will guide and control, to any good end, the professional conduct of the men who happen to belong to any one profession; and, indeed, that formulated codes are not only inadequate and futile, but actually harmful. To this the answer is, "But how else shall we take rank along with the other great professions; how have their standards of professional conduct been fixed and kept but by formal codes?" We have never heard of a special code of ethics for ministers of the gospel; they seem to get along as a profession with the ten commandments and the Golden Rule. We have been unable to find any formulated code of ethics among lawyers. Four years ago we inquired into this matter carefully and concluded that the ethics of the legal profession, so far as they are special to that profession, are a part of a great body of doctrine, made up of decisions of courts and associations, and of the precepts and example of eminent men, and exist only as oral tradition or incidentally in scattered writings. Among the doctors of medicine the code notion is distinctly waning. In recent years leaders in the medical societies have thought and said that the medical profession would be better off without a code, and there has been a steady movement toward limitation and final abolition of codes. In fact the Medical Society of the State of New York is practically without a code, as its very simple code is not recognized in its by-laws as a rule of conduct. So the argument from the other professions falls to the ground. Lately a gentleman was asked to referee a game of golf. He hotly declined on the ground that when it came to the point that a group of gentlemen could not play golf together without a referee they had better break their clubs and quit—and he was right. No code of rules complete enough and clear enough to make a cad play golf like a gentleman has ever been drawn, or ever can be. Much the same is true of practising a profession.

Professor Owens in his paper on the study of electrical engineering calls attention, in language duly diplomatic, to the fact that for the credit of the schools and for the prosperity of their graduates there must be a closer correspondence between the work of the schools and the best actual engineering practice. His argument is summarized on another page and we shall say no more about it here than to speak of one point. He brings up the fact that cultivating close relations between college work and outside practice is a part of the duty of the teacher, and he says that a limited consulting practice should be encouraged. This notion we have long held and have repeatedly urged upon members of college faculties when we have had occasion to talk with them on such subjects. Indeed the same theory holds with regard to editors and for the same reason. A man shut up in the narrow walls of a college or in the office of an editor, uttering day by day and week by week his undisputed dicta, comes gradually to think that his opinions are worth something because they are his opinions. Nothing is so bracing to the intellectuals and the morals of a man in such a situation as to measure himself occasionally alongside of men who are doing what we may call applied work in the world. After all the dollar is a very sensitive standard for measuring the value of a man's work and it is a most wholesome thing for the teacher to get out frequently and find out how many cold dollars his theories are actually worth. Of course this is only a partial statement. Beyond this tonic effect of doing outside engineering work, there is the actual acquisition of precise knowledge of what other men are doing, which one can get so well in no other way as in working alongside of them. Of course quite a contrary theory is commonly held. The heads of some of the most important institutions of learning object strongly to their professors and instructors doing outside work. But if a man has not conscience enough and character enough to do his duty by the school or the journal with which he is employed, that conscience and character cannot be fortified by tying him down to hours and routine.

The Railroads as Buyers of Supplies.

One of the most practically interesting pieces of information that anyone could gather and distribute to-day is whether or not the railroads are soon going to buy equipment and supplies. The answer depends a good deal on the business that they are doing and are likely to do in the next few months. A very good measure of the business of the railroads is the daily movement of loaded freight cars. Of this we have definite figures for a few typical roads.

The Illinois Central, for instance, moved during the month of July, 1897, an average of 6,426 loaded freight cars a day, and the increase over 1896 was 28 per cent., over 1895 about the same, and over 1894, 80 per cent. We are assured that the business on the Chesapeake & Ohio Southwestern is not included in the 1897 figures. For the first 10 days of August, including one Sunday, the daily loads averaged 6,303. The gain over 1896 and 1895 was not as large in percentage as for the month of July, but it was large, the 1896 movement having been 5,100 and the 1895 movement 5,459.

On the Chicago, Burlington & Quincy the average daily loads in July, 1897, were 2,691. The gain over 1896 was 12½ per cent.; over 1895 and 1894 it was even greater. The daily movement for the first 10 days of August averaged 3,565 loads. This compares with 3,275 in 1896, and 2,947 in 1895.

On the Rock Island the daily loads for July were 3,892; the increase from 1896 was 11 per cent. and from 1895 30 per cent. The first 10 days of August the loads averaged 4,732, the gain being 7 and 21 per cent. from the two years immediately preceding.

On the Atchison the daily loads in July, 1897, averaged 1,811, and the gain over 1896 was 15 per cent. For the first 10 days in August the average was 2,155 daily loads, and the gain was 20 per cent.

On the Wabash the coal traffic this year was virtually cut off; consequently the daily loads during July were less than in 1896, namely, 3,093 as compared with 3,408, but they were a little greater than in 1895 and almost 40 per cent. greater than in 1894. The average for the first 10 days of August, however, shows a substantial gain over 1896, notwithstanding the continuance of the coal strike. The daily loads moved were 3,819, while in 1896 they were 3,632.

Inquiry among the roads centering in New York has not brought out many specific figures. One of the great systems reports a movement of 373,617 loaded cars in July, 1897. In 1896 the loads moved were 344,663 and in 1895, 367,090. The increase for the month, therefore, was nine per cent. over 1896. On the same system the loads moved in the first and second weeks of August amounted to 181,690 this year, 148,931 last year, and 172,067 the year before, the increase over 1896 having been 22 per cent. This company has rolling stock enough.

Another of the great roads declines to give figures, but there is a very favorable increase in freight. While there is an increase in local, a large proportion of the general increase is in through freight, shipments of grain being very heavy. The outlook for business is good, but the road needs no rolling equipment.

The Baltimore & Ohio people say that their freight traffic almost doubled in July of 1897, as compared with 1896. On the New York, Ontario & Western, aside from the coal traffic, the general freight business shows a respectable increase.

On the Long Island the cars moved in the month of July, 1897, were 25,523, a gain of 17 per cent. over 1896 and nearly as great over 1895. In the first week of August the cars moved, in 1897, were 5,889, the gain being 17 per cent. over 1895, and the second week in August shows almost the same movement as in the first. This road is not affected by the grain movement, but the increase involves a special element. It is to considerable degree accounted for by the carriage of road material—a movement that has recently been greatly stimulated by the officers of the Long Island road as well as by the wheelmen.

Returning to the Chicago roads: On the Illinois Central the greatest recent gain is in coal, grain and lumber. The lumber movement has been stimulated by active work at Pullman, and also by fair demand for building material. The coal movement has been good, because the mines on the Illinois Central have not been seriously affected by the strike. The officers of the road anticipate about all the business that they can handle this fall, largely, of course, because of the heavy movement of grain. They are well provided, however, with cars and locomotives, and contemplate no important increase in equipment.

On the Chicago, Burlington & Quincy, the increase is largely in grain and live stock, but the general merchandise business is good. The July business would have been greater but for the coal strikes, the mines on the line of that road having been either closed or seriously interrupted. The officers of the road look forward to at least five years' good business. The company is well provided with equipment and no large increases are needed. It is not expected that there will be any shortage of cars before the Lake navigation closes, which will probably cause a car famine west of Chicago. The increase of length of locomotive runs has been beneficial in getting greater service out of a given number of engines.

From the Chicago & Northwestern no definite report of car movement is obtained, but the business is heavy, especially in grain and live stock, and they expect all the business they can handle for some time to come. On the Chicago & Alton, the July business was not up to the normal, due partly to the coal strike and partly to low grain rates which the Alton would not meet. The outlook for business, however, is now better, and it is expected that a large increase will be shown as soon as the trouble with the miners is ended. A big fall business is expected.

On the Michigan Central there have been important increases in traffic since the middle of July. There is a decided improvement in the movement of general merchandise. The heavy grain movement on that road does not normally take place until after the close of lake navigation.

On the Atchison the gain in car movement would have been greater but for the coal strike. We have seen, however, that it is substantial and it is expected that by the autumn the road will be doing all the business that it can handle. It is not the intention, however, to materially increase the car equipment.

It will be seen that these figures and opinions confirm the general reports which we have been receiving from various quarters for some weeks. The same conclusion is reached by an examination of the most recent figures of earnings. The compiled reports of gross earnings show a gain of 5.16 per cent. in the month of July on 127 roads covering 101,000 miles, while such earnings as have been compiled for the first week of August show a gain of over 10 per cent.

It will be observed that these reports suggest that there is not likely to be much increase, for a while at least, in locomotive and car orders. A canvass of the locomotive and car builders is instructive. We are not permitted to give names or definite figures, but can give some impersonal facts and opinions.

One locomotive builder shows a gain in orders for the first seven months of the year of 18 per cent. as compared with 1895. This is for domestic orders; foreign orders, which are now somewhat important in several locomotive works, are not significant in the inquiry now making. This same concern says that conditions have improved materially in the last few months; no great amount of business has yet developed, but there is more disposition to place orders for locomotives.

Another important builder says that the engines ordered so far in 1897 are fewer than for the *whole* year of 1895 or of 1896, but more than for the whole year of 1894, and several months yet to come. Inquiries justify the opinion that a better feeling prevails and the hope of better times than have been experienced for the last few years.

Another large builder says that the actual orders for the first six months of this year are nearly 40 per cent. more than for the corresponding period of last year. The judgment of that concern is that we shall see more activity in locomotive building this fall and winter and that next year the business will be brisk. This opinion is not based on orders of which they have knowledge, but upon the general business situation.

Another locomotive concern is much encouraged, but does not look for many orders until fall, when it is believed the railroads will be buying pretty largely. Prices are as low as they have been at any time. Another locomotive concern has turned out in the first seven months of the year 50 per cent. more work than in either one of the three preceding years. The work of this concern is, however, somewhat special. Another locomotive concern says that the outlook for better business in the railroad trade is very bright. "So far as our shops are concerned, we are quite busy and from inquiries received expect a good fall and winter business."

The car builders are anything but sanguine. One concern has found less activity than in 1896, which, however, was a prosperous year for that concern. They feel inclined to say, however, that business will be better, as they have an unusual number of inquiries, especially for export.

Another very important concern is content with saying that "in general our business looks more satisfactory within the last two or three months than it has previously done for a long time." Another car-building concern is doing about the same business as in any one of the last three years. There has been no improvement in the last month or two, but there is considerable talk of more business. However, still another concern that is doing a much greater volume of business than in either of the last two or three years, considers that conditions have materially improved in the last month or two and anticipates a decided increase of business in the fall and winter.

Still another car-building concern did less business in the first six months of 1897 than in the first half of 1896. The indications seem to be, how-

ever, for a somewhat better business for the last half of the year; still the railroads are not enthusiastic in ordering cars. Another car builder says that '97 has been the dullest year of recent times; but another concern says that business, if anything, is a little better this year than last. There appears to be a steady improvement, but no rapid advance in price is anticipated, although inquiries were more numerous. On the whole, the outlook there is encouraging.

This sums up fairly the replies that we have received from these branches of the supply trade, and the most that can be said in a general way is that they are fairly hopeful, if not sanguine. We should be glad to be able to say that the "boom has struck" the railroads and the supply-houses, but probably it will be safer to wait a week or two. We can, however, safely say that the definite figures and the general expressions that we have given above are confirmed on all sides and in a thousand ways. Indeed, we should judge that in general commercial business there is considerably greater activity than there seems to be in any of the businesses closely allied to railroading, and a marked tendency toward better prices. We conclude from all this that a speedy and important improvement in the branches of trade immediately dependent on the railroads is about as inevitable as anything but death and taxes. The railroads may have enough cars and engines today; but they will not have enough when the earnings have begun to pile up so steadily that officers and directors feel safe in spending the surplus or in borrowing.

July Grain Exports.

The government report of grain exports for July furnishes some incidental evidence of the weakness of the Joint Traffic Association, the exports of grain from New York being more than from all the other principal Atlantic and Gulf ports combined. In corn alone, of which there is much more than of any other one grain, and which is the one that the New Yorkers seem most fearful of losing, New York's percentage is 41, the port next in rank being Baltimore, with less than two-thirds as much as New York. Of wheat Baltimore exported the most, but of oats New York had 78 per cent., thus bringing its percentage of all three grains up to 51, as shown in the table.

The aggregate of exports from all these ports, over 17 million bushels, makes a magnificent showing, and in the general mercantile aspect of the matter there is nothing to regret or deplore, but as an indication of the power of a voluntary association to maintain transportation rates without a pool it is somewhat discouraging.

A man who had been asleep 20 years would say that this great advance in grain exports at New York in summer must have been due to the Erie Canal; but, as we showed by figures published last week, this is not the case. For the three months to July 31 the railroads brought to New York more than four times as much grain as the canal, another discouraging fact—for the boatmen.

True, the railroads have made very low rates to get this grain, and have thus benefited the farmer and the consumer; and we must conclude that they make some profit on the business or they would not make large contracts for long terms, as it is said they have done. Grain has been carried by rail from Buffalo to New York at about 2½ cents a bushel, and the railroads must know by this time whether or not they lose money at this rate. But when the Joint Traffic Association was at its best, when every trunk line was bound to it in writing and no one had found it necessary to draw on his reserve magazine of traffic tricks in order to retain his business, it was understood that the New York roads could afford to let the more southerly lines give lower rates rather than have a general demoralization. As this seems to have been the honest opinion of the stronger roads, the only conclusion to be reached from the present facts seems to be that the grain is being carried at unreasonably low rates. Some one road, the one which was first to cut, has sacrificed a large amount of revenue, and in pulling down its own house has pulled down its neighbors' with it. In view of the new competition that has arisen in the last few years, and other economic changes, the sacrifice is not so outrageous as has been the case in former years, but still it is, no doubt, serious.

GRAIN EXPORTS FROM ATLANTIC AND GULF PORTS (IN THOUSANDS OF BUSHELS).

	Corn.		Wheat.		Oats.		Corn, wheat and oats.			
	1897.	1896.	1897.	1896.	1897.	1896.	1897.		1896.	
							Quantity.	P. c.	Quantity.	P. c.
New York—July	3,910	1,239	895	1,718	4,088	3,312	8,893	51	6,869	46
7 mos. to July 31	17,687	9,775	10,210	10,539	14,109	10,601	42,006	29	30,915	32
Boston—July	983	806	274	1,019	842	444	2,099	12	2,269	15
7 mos. to July 31	5,817	2,603	5,399	4,547	2,690	1,258	13,906	9	8,408	9
Philadelphia—July	1,097	515	184	160	140	.....	1,421	8	675	5
7 mos. to July 31	15,066	4,032	1,214	1,532	400	409	16,680	11	5,973	6
Baltimore—July	2,521	1,072	1,125	946	140	809	3,786	21	2,827	19
7 mos. to July 31	27,889	12,566	2,344	2,293	2,632	1,658	32,865	22	16,517	17
New Orleans—July	395	265	166	349	10	3	571	3	617	4
7 mos. to July 31	18,623	13,464	455	1,357	648	98	19,726	13	14,919	16
Galveston—July	171	32	24	.....	.....	....	195	1	32	0
7 mos. to July 31	3,664	3,688	95	21	.....	....	3,759	3	3,709	4
Newport News—July	239	43	40	.....	.....	705	279	2	748	5
7 mos. to July 31	10,872	6,285	61	13	399	2,594	11,332	8	8,892	9
Norfolk—July	293	707	.....	.....	....	....	293	2	707	5
7 mos. to July 31	7,442	6,942	....	.....	.....	..	7,442	5	6,942	7
Total—July	9,609	4,679	2,708	4,192	5,220	5,873	17,537	100	14,744	100
7 mos. to July 31	107,060	59,355	19,778	20,302	20,878	16,618	147,716	100	96,275	100

American Association for the Advancement of Science—Detroit Meeting.

Though not very largely attended, the Detroit meeting of the American Association for the Advancement of Science, held Aug. 9-13, was a successful one, if the number of valuable papers presented is any indication. The proceedings of the section of Mechanical Science and Engineering included many papers of interest and value to engineers. The annual address before the section by the Vice-President, Prof. John Galbraith, of Toronto, was on "The Groundwork of Dynamics." Dynamics as a science and its relation to the laws of energy were discussed at some length, and, in concluding, he said:

The science of dynamics, as it is understood at the present day, includes among its fundamental principles, in addition to the law of motion, the principle of the equivalence of work and energy, and the principle of the conservation of energy; energy being measured, however, only in terms of force and displacement, or momentum and velocity. The only actions known in dynamics are force and its integrals, impulse and work. To identify with these all the other actions involving the transfer and transformation of energy, such as the conduction of heat, chemical reactions, induction of electric currents, etc., forms to day the severest task of mathematical physics."

Below we give abstracts of some of the papers presented.

"*Development of Industries by Engineering Research.*" *By W. S. Aldrich.*

Industries dependent upon an application of engineering science can hope to maintain their present high standard of excellence or further to advance their interests only by the application of scientific method in the development of engineering research along their respective lines. The research laboratory is as indispensible as the testing laboratory, while their functions are quite distinct. In the development of new engineering industries the former is even more important than the latter.

"*The Cement Laboratory as a Field for Investigation.*" *By Fred P. Spaulding.*

Notwithstanding the large amount of experimental investigation of recent years, knowledge of the nature and properties of hydraulic cement is still in a very crude state. Much difference of opinion exists among the investigators concerning the reasons for observed phenomena, while engineers differ radically as to the best method of use. The subject presents, therefore, an attractive field for research.

Investigations upon cement usually require many experiments and used to be extended over long periods of time. Much data has recently accumulated, throwing light upon many difficult points, but the results in many instances seem conflicting and involve the question in much confusion. The tendency to make a few experiments and draw general conclusions from insufficient data has been very marked in this line of work. Failure fully to investigate the character of the material used, or to note clearly the conditions under which the experiments are made, causes much confusion in comparing the work of different experiments. Every detail of manipulation is important, and great care and accuracy are essential to good results.

"*Strength of Aluminum Zinc and Aluminum Tin Copper Alloys.*" *By R. C. Carpenter.*

The paper describes the methods of making the above alloys with different proportions of the various component parts, and also gives the tensile strength of various alloys: The aluminum zinc alloy has a maximum strength when it contains 25 per cent. zinc and 75 per aluminum. Its strength is about 1½ that of pure aluminum, and 10 times that of zinc. This alloy is an exceedingly useful one, and it can be used as a substitute for brass in nearly all kinds of construction. It melts at about 1,000 deg. Fahr., it can be cast easily and readily, and has a specific gravity slightly over 3. On account of its low specific gravity it is much cheaper than brass, and on account of its excellent working qualities it will be found very available for many purposes. This alloy has been used extensively in the construction of models in the deartment of marine engineering at Sibley College. The aluminum, tin and copper alloys show even a greater variation in strength than the aluminum-zinc alloy. In this case the tensile strength of the best alloy is 63,000 lbs. per square inch, while its constituents have strengths respectively 25,000, 15,000 and 5,000 lbs. per square inch. The composition of the alloy of maximum strength is 87½ per cent. copper, 6¼ per cent. aluminum and 6¼ per cent. tin. Another useful alloy, which was composed of 80 per cent. aluminum, 10 per cent. tin, 10 per cent. copper, has a tensile strength of 21,140 lbs., or about the same as that of cast iron, and a specific gravity of 3.

Both the above alloys are readily made, easily worked, and should prove of considerable value in the arts, but all other combinations of aluminum, tin and copper are inferior.

"*Investigation of the Strength of Wrought Iron at Low Temperature.*" *By R. C. Carpenter.*

The paper describes in detail the method of making the test, and gives the results of those made on an Emery testing machine of 200,000 lbs. capacity. These were conducted through a range of temperature from 70 deg. above to 70 deg. below zero. The general results of the test show a total increase in strength with decreasc in temperature amounting to 20 per cent. of the strength at 70 degs. without sensibly affecting the modulus of elasticity orthe elongation. The investigation also shows that a low temperature does not tend to increase the brittleness of wroght iron.

"*The Advisability of Agreeing upon a New and Conventional Elastic Limit.*" *By J. B. Johnson.*

The elastic limit defined as a *limit* is a function rather of the apparatus employed to find it and of the observer than of the material. It is, therefore, not characteristic of the material.

A new limit, defined as the stress at which the rate of deformation is 50 per cent. greater than it is within the field of perfect elasticity, has been adopted in the U. S. Timber Tests and is now recommended for general adoption for all practical purposes. This new limit never corresponds to a deformation of more than a very small part of one per cent. and has been found to serve all practical purposes and to be independent of the means employed to find it. It was generally approved by the members of Section D.

"*A Machine for Determining Friction.*" *By Thomas Gray.*

This is a machine for determining the friction of journal bearings such as are used in locomotives or railroad cars under all conditions of pressure up to the heaviest load.

The apparatus for producing pressure is entirely swing or knife edges, so that the application of the pressure to the journal does not influence the indication of the amount of friction. The object of the machine is to obtain the limit of applicability of various bearing materials and various lubricants.

"*A New Formula for the Width of Belting.*" *By J. J. Flather.*

The formula takes account of the influence of form of joint, weather-cemented or laced, also thickness of belt, diameter of pulley if small, arc of contact and centrifugal force. The formula as presented is

$$b = c\ c'\ c''\ k_0 \frac{H}{V} \frac{P}{}$$

in which the coefficients have suitable values presented in tabular form.

Other papers of interest to railroad engineers were "The Effect of Spark Losses in the Efficiency of Locomotives," by W. F. M. Goss (read by title); "Graphical Solution of Belting Problems," by J. J. Flather, and "A New Apparatus for Testing Indicator Springs," by M. E. Cooley. In this last-mentioned paper, Professor Cooley describes an apparatus invented by him, and used constantly in the mechanical laboratory of the University of Michigan during the past year with very satisfactory results. Its simplicity of construction and certainty of operation will commend the apparatus to engineers. Details may be given later. Prof. D. S. Jacobus gave a preliminary note to his paper on "Flue Analysis in Boiler Tests." The paper points out some of the errors that must be guarded against in flue gas analysis, and give the results of tests with the Elliott apparatus.

Prof. F. W. Putnam, of Harvard University, was elected President of the association, having served as Permanent Secretary for 26 years; Prof. M. E. Cooley, of the University of Michigan, was elected Vice-President of the section on Mechanical Science and Engineering, and Prof. Wm. S. Aldrich, of the University of West Virginia, Secretary. Prof. D. S. Kellicottt, of the Ohio State University, was made General Secretary; Mr. L. O. Howard, of Washington, D. C., Permanent Secretary; Prof. F. Bedell, of Cornell University, Secretary of the Council, and Prof. R. S. Woodward, of Columbia University, Treasurer.

The next meeting, to be held at Boston, Aug. 22, 1898, will celebrate the fiftieth anniversary of the founding of the association, and the occasion promises to be one of great scientific interest.

The Power Plant, Pipe Line and Dam at Ogden, Utah.*

BY HENRY GOLDMARK, M. AM. SOC. C. E.

[In our issue of Sept. 25, 1896, we gave some of the features of the plant described in this paper together with a view of the valley of the Ogden River. While the information here published repeats in part the description of the electrical features there given, yet this account of the work brings the subject up to date and gives more in detail the particulars of this installation.]

It is proposed in the following paper to describe the works recently built in the cañon of the Ogden River, near the city of Ogden, by the Pioneer Electric Power Company of Utah, which constitute the latest and most important hydraulic power plant of that state, and one of the largest works of the kind yet undertaken in this country.

The city of Ogden is situated in the basin of Great Salt Lake, at an elevation of 4,300 ft. above sea level. It is about 13 miles east of that body of water, and 35 miles north of Salt Lake City. The limits of the city extend eastward to the base of the Wahsatch Mountains, which tower 5,000 ft. higher, reaching a total altitude of fully 9,000 ft. above sea level.

The average annual rainfall in Ogden is 14 in. In the Ogden Valley it has never been measured, but is probably twice as great. The drainage area is about 360 square miles. The flow of the river varies greatly in different years and at different seasons. In May and June, when the snow on the mountains melts, a maximum flow of 4,800 cu. ft. per second has been measured, while a minimum of 80 cu. ft. in August and Sepeember is also on record. The minimum in average years is fully 125 cu ft. per second. In 1896 the flow did not go below 175 cu. ft. per second.

The slope of the stream in the upper valley is comparatively gradual, while in the six miles of the canon there is a total fall of nearly 500 ft. This portion of the river has long appeared an attractive field for the development of power, but apart from a small saw-mill near its mouth there have been only abortive attempts made at utilizing the fall of the stream, and none of these earlier plants are now in operation.

The conception and successful completion of the works belonging to the Pioneer Electric Power Company are largely due to the efforts of C. K. Bannister, M. Am. Soc. C. E., who, as chief engineer and secretary of the company, has devoted several years to the careful study of the engineering and financial problems involved. Preliminary surveys were made in 1894 and 1895, but it was not until the beginning of 1896 that the location of the plant was definitely settled and actual construction begun.

General Description of the Works.

The plans of the pioneer Electric Power Company contemplate the utilization of the waters of the entire Ogden River water-shed above the mouth of the canon for the development of power as well as for irrigation. The central features of the plant are: A large storage reservoir and a masonry dam at the upper end of the canon; a pipe conduit 6 ft. in diameter: a power-house containing water wheels and electric generators. Besides this, there are electric transmission lines and substations for distributing the power to different points, and an extended system of irrigation canals.

The storage reservoir will cover an area of about 2,000 acres, and will have a capacity of nearly 15,000,000,000 gals. It will be formed by building a dam across the canon a short distance below its upper end.

The dam will be built of concrete masonry and founded on the bed-rock. Its length, measured on the crest, will be about 400 ft. It will be about 60 ft. high above the present river-bed, and the foundation will extend about 40 ft. lower, making a total height of over 100 ft. The sides and bottom of the canon, at the site of the dam, consist of solid limestone rock, but the bottom is overlaid to a depth of about 40 ft. with coarse gravel containing a large amount of ground-water. A spillway for carrying off the flood waters is to be built on the north side of the canon.

A 9-ft. tunnel has been excavated through the solid rock around the south abutment of the dam, which, at ordinary stages of the river, will be the sole outlet for the water in the reservoir. It is to connect at its upper end to a masonary inlet tower, with six 60-in. ports and sluice gates for admitting water.

About 100 ft. below the tunnel, and connected to it by a riveted steel piped 8 ft. 6 in. in diameter, the main gate-house is placed. This building contains two 72-in. valves, one of which serves for discharging surplus water, while the other connects with the main conduit.

The main conduit is a pipe line with an internal diameter of 6 ft. Its total length is 31,600 ft., of which 27,000 ft. consist of wooden stave pipe, while the last 4,600 ft., at the lower end is riveted steel pipe. It is laid in a trench 8½ ft. wide, and covered with earth to a depth of 3 ft. on top. The wooden pipe is located on the side of the canon with maximum horizontal curves of 14 degrees and vertical curves of 8 degrees, and follows the side of the mountain to a point about half a mile beyond the mouth of the canon. The hydraulic grade line is assumed to fall at the rate of 0.2 per hundred, and the wooden pipe is kept close to, but below, a gradient of this slope, which begins at low-water level in the reservoir. The upper portion of the wooden conduit is mainly in earth excavation, but toward the mouth of the canon the trench was excated almost entirely in limestone and granite rock. There are eight tunnels in the rock, the longest of which is 667 ft. There are also eight steel bridges, with a total length of 560 ft. besides a timber trestle. The maximum hydrostatic head on the wooden pipe will be 117 ft., giving a pressure of 50 lbs. per square inch.

Steel pipe is used at the lower end of the conduit for pressures exceeding that mentioned above. It extends from the lower end of the wooden pipe to the power-house, following an alignment which is straight in plan, but is adapted to the contour of the ground by 14 vertical angles. Between these points the pipe is straight, the elbows being formed with radii of 30 ft.

The steel pipe is of 6 ft. diameter till it reaches a point 100 ft. above the power-house. Here it divides into two branches, 54 in. in diameter, which lead to two large receivers, one on either side of the power-house building. The total hydrostatic head from the flow line of the reservoir, when it is full, to the center of the receivers will be 516 ft.

The power-house is built of pressed brick, with concrete and rubble footings and cut stone trimmings. Its outside dimensions are 135 ft. in length by 50 ft. in width. The roof trusses are of steel, and are supported on steel posts imbedded in the brick walls. The covering consists of standing seam steel roofing laid on a 2-in. sheeting of Douglas fir. A traveling crane of 15 tons capacity, operated by hand power, traverses the building, the track girders being carried by the steel posts. This building contains all the hydraulic and electric machinery used. A smaller, separate building serves as a machine and blacksmith shop.

The pipe line is calculated to deliver 250 cu. ft. per second with a full reservoir, which corresponds to a velocity of flow in the 6-ft. pipe, or about 9 ft. per second. Taking the effective head at 440 ft., the gross available horse-power will be about 12,500.

The prime movers used are water wheels of the impulse type, direct connected to electric generators. The complete plant will consist of 10 water wheels and dynamos, but only five are at present installed, although the power-house building, the receivers and the machine foundations have been built in such a way that the whole number of machines can be erected at any time. The water wheels are of the Knight pattern, 58 in. in diameter, with a capacity of 1,200 H. P. each, at 300 revolutions per minute. The dynamos are three-phase alternating-current generators. They give an output of 750 kilowatts at 300 revolutions per minute, and 2,300 volts continuously, with a frequency of 60 cycles per second. Continuous current exciters, step-up transformers and the other necessary machinery are all placed in convenient locations.

The long-distance transmission lines are, at present, about 38 miles in length, extending to a sub-station in Salt Lake City. They deliver the current, at a voltage of 13 800, to the step-down transformers, which reduce it to 2,300 volts for local distribution. There are, besides this, wires for the local distribution of power in Ogden. The current in these lines has a voltage of 2,300.

The irrigation canals belonging to the company are situated near the shore of Great Salt Lake. The water from the pipe conduit, after leaving the power-house, is allowed to run back into the natural bed of the stream, and is again taken out, at a point about five miles below, and diverted, so as to irrigate about 18,000 acres of land, not heretofore provided with water.

All portions of the plant are at present complete and ready for operation with the exception of the large dam and reservoir, the construction of which has not yet begun. A small crib dam with temporary headworks has been built a short distance above the site of the large dam, which gives the necessary head for filling the pipe, but does not provide for any considerable storage of water. A temporary stave pipe, 54 in. in diameter, extends from the crib dam to the 9-ft. tunnel. In this way, the power plant can be operated and a considerable amount of power generated prior to the construction of the large concrete dam.

The Conduit, Its Hydraulics and Construction.

The conduit consists approximately of five miles of wooden stave pipe and ⅗ mile of riveted steel pipe. The former is everywhere 72½ in. in internal diameter, while the latter has an average internal diameter of 72¼ in., but varies slightly at different points. As a 6-ft. steel pipe is from three to four times as expensive per lineal foot as a wooden pipe of the same size, economy prescribed a location by which the length of the metallic conduit should be reduced to a minimum. Besides this the capacity of the smooth stave pipe is considerably greater than that of the steel pipe, so that, from hydraulic considerations, the use of wooden pipe is preferable. For both of these reasons the cheaper pipe is used from the dam to a point close to the power-house. Its location is such as to reduce the pressure that comes upon it as much as possible without increasing the excavation unduly. Hence the wooden pipe line is built to conform to a hydraulic grade line of 2 ft. per thousand, a slope which is believed to correspond to the friction in the pipe. A large amount of curvature is introduced, but the radii are large, so that the obstruction to the flow is probably inappreciable.

From the end of the wooden pipe, the steel conduit runs direct to the power-house. The slope of the steel pipe is quite steep, and the pressure is from 50 to 200 lbs. per sq. in.

For moderate diameters the choice between cast iron and riveted steel pipes will usually depend on local conditions. For a 6-ft. pipe under such heavy pressures and at so great a distance to the nearest pipe foundries, the use of cast iron was entirely out of the question The objections raised against the use of riveted conduits are their greater liability to corrosion and their smaller capacity, owing to greater frictional resistance. In the Ogden pipe, great care was taken to prevent the rusting of the plates in transit and at the shops, and a coating of asphalt was afterward applied by which a long life for the pipe is believed to be fully assured.

Just how much less will depend on the nature of the construction and of the coating, the size of the pipe and the slope of the conduit. The recorded data for the flow of water in pipes exceeding 4 ft. in diameter are very scanty, even for smooth internal surfaces. For riveted conduits there are almost none in existence. Various formulas are in use for computing the frictional resistances for new cases as they arise. The best of these are confessedly empirical, merely combining in a convenient shape the results of a number of measurements. When applying them to novel conditions, the results can be only approximate, though the designing engineer must fall back on such inductions in determining the size of conduits differing from previons examples. It is a cherished hope of the projectors of the Ogden pipe that it may furnish an opportunity for a series of careful experiments which may throw additional light on the flow of water in large pipes.

There are 13 elbows of 30-ft. radius in the steel pipe, and one elbow of 40-ft. radius. From the end of the 6 ft. pipe, two 4½-ft. branches about 100 ft. long lead to the power-house.

[The frictional resistances in the wooden and steel pipes are then computed for a velocity of 8¾ ft. per second in the 6-ft. pipe, and it was found that for the whole pipe line (27,000 ft.) the loss of head will be 69.38 ft.]

A tensile strength of 60,000 lbs. per square inch, with an elongation of 24 per cent. in 8 in., corresponds in a plate ⅜ in. thick to a carbon percentage of about 0.15, if basic open-hearth steel is used, with phosphorus and manganese as specified. To obtain the same tensile strength and ductility in the ¾-in. plate rolled down from slabs or ingots of the same size, it is necessary to increase the carbon to fully 0.24. This means, of course, a much harder steel, which will be more subject to injury in subsequent processes of manufacture. The "rolling" of plates into cylindrical pipes causes severe strains in the metal, and experience has proved that much greater care is required in getting a perfect result in the thicker sheets. For this reason it would be desirable to modify the specifications for plates so as to provide that the tensile strength required in the thicker plates should be less than in the thin ones. The chemical composition of the steel would then be more nearly the same, and the capacity of the heavier gages for standing the necessary strains in the boiler shop would be increased.

All the work connected with the construction of the steel pipe sections was done at Ogden in a shop especially built and equipped with machinery for the purpose by the contractors. The principal reasons for adopting this plan were, first, the great saving in freight charges which resulted from being able to ship flat plates up to the full capacity of the cars instead of the finished pipe sections of which, for the lighter gages, hardly half a carload could have been loaded on a standard flat car; and, second, that both work and inspection might be under the personal supervision of the chief engineer and his assistant on the pipe line.

Great care was taken with the calking of the joints. It was done entirely on the outside straps by the use of split calking machines driven by compressed air. The calking was generally done while the section was suspended above the riveter, so that the outer row of rivets in the longitudinal butt-straps could be driven after the calking was finished. The calking of one edge of the round straps had, of course, to be done after the pipe was laid in the trench.

As soon as a section was completed it was taken to the dipping tank adjoining the shop, which was equipped with a revolving derrick moved by steam power. The tank was circular, made of ¼-in. steel plates, and buried entirely below the ground. The mixture used consisted of C grade California asphalt, with the interstices filled with the best quality of natural liquid asphalt maltha, not above 14 deg. gravity Beaume test. The mixture was melted and kept at a proper temperature by steam coils in the tank. It was found that a prolonged process of coating give the best results, and for this reason nearly an hour was consumed in dipping each section, and gradually withdrawing it from the boiling mixture. The coating was smooth and glossy, and stood the necessary handling without much damage.

The riveting of a steel pipe line of the diameter and length of the Ogden pipe in the short period of time to which the contractor was limited presented many difficulties. For the 1⅛-in. and even 1-in. rivets hand work was not practicable, and it was undesirable even for the ⅞-in rivets Power riveters for this class of field work were almost if not quite untried, and there was little time for experiments Two forms of power riveters were specially designed for the work, and all the rivets were driven with them, there being practically no hand riveting on any part of the pipe. They were both operated by compressed air, which was drawn from a small pipe laid down on the edge of the trench for the entire length of the steel conduit. This pipe was 3 in. in diameter where it left the compressor in the boiler shop, decreasing to 2 in. at the upper end. The pressure used varied from 50 to 75 lbs. per square inch.

When the first 10 sections of 1⅛-in. pipe were riveted up in the trench, making a total of 92 ft. of completed pipe, they were closed at each end by dished heads, which were bolted fast and calked with lead. The pipes were filled with water and subjected to hydraulic pressure. For this purpose the air compressor was speeded up so as to give a pressure of 200 lbs. per square inch, which was maintained for 12 minutes, when it was stopped from fear of injuring the rather light compressor used. While the compressor was at work, the pressure was raised to 250 lbs. per square inch at intervals by a hand-pump. This last increment of pressure was applied as a jerk or kind of water-hammer, so that as a test it was doubly severe. Under this pressure the pipe proved to be very tight. Out of some 3,000 rivets only 22 were discovered that leaked at all, and most of these merely sweated. The calked joints were also practically tight, showing only a few slight leaks. These sections were the first built. The latter work would probably, if tested in like manner, have given even better results.

The wooden stave pipe is of the type successfully used in the West for many years. It is believed, however, that its diameter of 6 ft. is greater than that of any conduit of the kind previously built. A new departure, too, is the use of Douglas fir in place of California redwood. The former timber is much harder and stiffer, and some trouble was anticipated in its use for staves, especially in view of the great amount of curvature in the pipe line. After the first few days, however, no great difficulty was experienced in putting the staves together properly, even on the 14-deg. curves.

The lumber used was beyond criticism, being practically perfect in appearance. It was, as far as possible, thoroughly seasoned and dried, and was kept under cover at Ogden until it was placed in the trench. The pipe was built of 32 staves, the finished staves being 7⅛ in. wide on the outside, 7⅛ in. wide on the inside and 2 in. in thickness.

According to the specifications, the length of staves were to be 16, 18 and 20 ft., but no more than 15 per cent. of 16-ft. lengths, nor more than 30 per cent. of 18-ft. lengths, were allowed. This condition was fully complied with, and many lengths of 24 ft., 26 ft. and even more, were used.

Many different methods for banding stave pipe have been proposed from time to time, but only a few of them have had the test of practical experience. In the early pipe lines, bands similar to those used on barrels were employed, but the use of round rods of steel has now become universal for all but the smallest sizes. There are, however, many different forms and details for connecting the rods and making the necessary adjustments.

On the Ogden pipe the bands consist of round steel rods of ⅞-in. and ¾-in. diameter, the latter being used only where the pressure exceeds that due to a head of 100 ft. They were made of tested steel, having an ultimate strength in tension of between 55,000 and 65,000 lbs. per square inch, an elastic limit of 40,000 lbs. per square inch, and an elongation of 25 per cent. in 8 in. The percentage of phosphorus was not to exceed 0.095, and of sulphur 0.075. Each rod was to bend cold through 180 deg. upon itself without sign of fracture.

There are nine bridges on the line of the pipe line, of which one if a timber trestle, while the rest are built of steel. Besides these, all of which carry the wooden pipe, there are a few short culverts under both the wood and the steel pipes.

Hydraulic and Electric Machinery.

For the following description of the hydraulic and electric machinery, the author is indebted to Mr. L. S. Boggs, the electrical engineer of the Pioneer Electric Power Company, in charge of its erection.

The installation comprises the following apparatus: Five, 750 KW. polyphase 2 300-volt generators; two, 100-KW. direct-current 500 volt exciters; five, 1 200-H P. Knight water-wheels; two, 135-H. P. Knight water-wheels; one 7-panel generator switchboard; one 12-panel distributing switchboard; nine 250-K W. step-up transformers; two blowers or cooling outfits; one 15-ton traveling crane; two Venturi water meters.

As noted in the general description of the works, the water is delivered from the pipe conduit into two receivers, which are buried in the ground, one at either side of the power-house. They are 6 ft. in diameter, and, in their general appearance and the material used, closely resemble the regular steel pipe conduit. It may be noted, however, that the thickness of the metal is in-

* From a paper presented at the annual convention of the A. S. C. E., held at Chateau Fontenac, Quebec, June 30-July 2, 1897.

creased to 7/8 in. in order to allow for water-hammer. Besides this, the edges of all plates and straps were planed, and the rivet-holes reamed out fully 1/8 in. after punching.

The receivers are provided with five safety valves each, which discharge when the pressure exceeds 200 lbs. per sq. in., and an outlet gate at the bottom. From each of these receivers five 30-in. and one 10-in. intake pipes extend to the walls of the power house to connect with the water wheel nozzle pipes. Between these intakes and the nozzle pipes are placed the following valves, in the order named: One 18-in. geared gate valve, one 18-in. hydraulic gate valve and one 18-in. butterfly valve; the first named is only to be used in case of repairs to the particular machine that it governs, and is left open on all other occasions.

The water wheels are 58 in. in diameter and have 45 bronze buckets cast in one solid piece; 14 of these will, when the nozzle ports are all open, receive the water at the same instant. The centers of the wheels are made of cast steel, the buckets being pressed on these steel centers, and secured with turned bolts, fitted in reamed holes, passing through both pieces of metal. These wheels were bored to fit, and are keyed to the generator shaft, each wheel being faced and perfectly balanced.

Each water wheel is provided with two flywheels, about 70 in. in diameter, each of which weighs about two tons, and is placed inside of a housing on each side of the wheel. These flywheels are banded with 3/4 × 5-in. Ulster iron, shrunk on hot. They are split in three parts and are filled with metal, banded, bored to fit and keyed to the generator shaft. They are turned on the face and nicely balanced.

The generators used in this plant are of the General Electric type, with 24 poles, and, at 300 revolutions per minute, have an output of 750 KW. at 2,300 volts, and a frequency of 60 cycles per second, and the factory tests show that the variation in volts will be less than 5 per cent. with a constant speed, should the full non-inductive load be thrown off or on.

The bed plates of the generators were filled with cement after they were leveled up and securely anchored to their respective foundations. Between the machine foundations and the building foundation wall, on each side of the building, is a subway which runs the entire length of the building and across the rear, and in this subway are carried all the necessary piping for water-wheel controllers and all the wires between the generators and the switchboards. The cable connecting each generator to its respective panel on the generator switchboard is a three-wire concentric 250,000 c. m. lead-covered cable, and the exciting wires are a two-wire concentric No. 4 B. & S. lead-covered cable. In fact, all the machines connections to the switchboard are lead-covered cables.

The exciters used in this plant are six-pole 500-volt machines, and will give 100 KW. at 550 revolutions per minute. Each of these machines is ample for the entire exciting current that will be needed for the 10 750-KW. alternators, and they are each direct connected to a 135-H.P. Knight water wheel similar in every way to the 1,200-H.P. water wheels previously described. These exciter water wheels are cross-connected to each receiver, so that either exciter can be operated from either receiver. The advantage of this is self-explanatory.

The generator switchboard consists of seven marble panels; five of these are for the alternators, one for the exciter, and one the instrument panel.

The current is fed into the transmission line at the power plant at 16,100 volts and delivered to the step-down transformers at 13,800 volts. This will give an energy loss of about 10 per cent. in the line, and a potential loss of about 14 per cent. The substation step-down transformers deliver this current to the local distributing lines again at 2,300 volts. There are at present nine 250-KW. step-down transformers at the substation, connected in a way similar to the step-up transformers, and the switchboard in the substation is similar in every respect to the distributing board in the power plant gallery. The cooling apparatus here is also identical with that used in the power plant, except that the motors used here are 60-cycle induction motors.

While the transmission lines are at present capable of delivering 3,000 H. P. at the substation, with a 10 per cent energy loss, if it should become necessary, the step-up transformers can deliver more than this by changing three wires on their high side and delivering the current into the transmission lines at 27,000 volts. Thus the line capacity would be more than doubled.

The present installation of the power plant is only capable of delivering 3,750-KW. to its lines, but ample provision has been made to increase this amount to 7,500-KW. by installing five more 750-KW. machines, as new industries or manufactures spring up as the result of the advantages offered to them in Ogden and Salt Lake City. All portions of the plant below the breeches pipe casting, at the lower end of the 6-ft. conduit, are absolutely symmetrical about the center line of the power-house, each side being entirely independent of the other. This applies not only to the pipe and the receivers, but to all parts of the switchboards, etc., as well as to generators and water wheels. Either one of the exciters, also, is capable of providing sufficient current for all the large generators, and can be run with water from either receiver. The advantage of this arrangement is that an accident to either receiver, or to one or more wheels or generators, would not result in the shutting down of the entire plant, but at the worst of only one side. For a short period all the required power could probably be supplied from one side of the power-house.

The Dam.

The plan finally adopted provides for a concrete dam consisting of isolated piers united by segmental arches. Both in the quantity of material used and the cost of construction it promises to be considercably cheaper than a dam of the usual type. It is believed, too, to meet all necessary requirements as to strength, water-tightness and durability. The statement as to the saving in cost is based on the result of an actual bidding made by a number of experienced contractors on detailed plans and specifications. While the bids differed largely as to the actual amounts, they were, in every case, considerably lower than the tenders for a masonry dam which were made at the same time.

In addition to this design, the question was studied of substituting a steel structure for the upper 60 ft. of dam. Although, under the conditions prevailing in Ogden cañyon, a steel dam proved to be uneconomical, there may be places where the result would be different.

The work was carried out under the direction of C. K. Bannister, M. Am. Soc. C. E., as Chief Engineer, while Messrs. Willard Young and H. M. McCartney successively held the positions of Assistant Chief Engineers. Mr. R. F. Hayward was Consulting Engineer for the hydraulic and electric equipment, while George H. Pegram, M Am. Soc. C. E., acted in an advisory capacity as Consulting Engineer. The location and early construction were in charge of Mr. F. N. Snyder, who was succeeded by Mr. S. E. Reaugh. To the author were entrusted the designing of the pipe conduit and its details, and the studies for the dam, as well as the mathematical and technical work connected with the plant, excepting the electrical and hydraulic machinery and transmissions. Mr. G. E. Rhodes was in charge of the work on the pipe conduits for the contractors, Messrs Rhodes Brothers.

TECHNICAL.

Manufacturing and Business.

J. A. Ellis, who for the past eight years has been in charge of the sales department of the malleable iron business of the Michigan Malleable Iron Co., has resigned to take the general sales agency for the United States for the Detroit coupler, which is made by the Michigan Malleable Iron Co.

The Barr vestibule, formerly made by the Drexel Mfg. Co., is now being made by the Railroad Supply Co., of Chicago.

The Toledo Foundry & Machine Co., Toledo, O., has just received an order for two Victor steam shovels, which are to be shipped to Japan in October.

The Ingersoll-Sergeant Drill Co., Havemeyer Building, New York City, has received an order to furnish air compressors for the pneumatic tube system now being built between the New York and Brooklyn post offices. The same company will supply compressors for a similar system now under way in Philadelphia.

The Conshohocken Tube Co., which has been in the hands of Receivers since April 14, and sold by them last month to a committee representing 90 per cent. of the bondholders for $250,000, has been reorganized under the name of the Conshohocken Tube Works Co., and work has been resumed. The officers and Directors of the new company are: President, Jawood Lukens, Conshohocken; Secretary and Treasurer, Lewis A. Lukens, New York. Directors: John Pugh, Henry M. Tracy, Albert L. Murphy, Conshohocken; John S. Gerhard, Philadelphia; William Wilson, Wilmington, and Lewis A. Lukens, New York.

The Payne Railroad Switch Equipment Co., of Ashtabula, O., has been formed with a capital stock of $50,000. Among the incorporators are Stephen R. Payne, H. J. Bailey and A. P. Laughlin.

Willis Shaw, dealer in contractors' machinery, 506 New York Life Bldg., Chicago, reports the following sales: Car hoisting engines to Lantry Sons, Pontoosuc, Ill.; two narrow-gage contractors' locomotives to Peppard & Johnson, Minneapolis, Minn.; a 30-ton locomotive to the Ganahl (Ark.) Lumber Co.; an equipment of Shaw dump cars to the Carey Construction Co., Fort Worth, Tex., and pumps and boilers to Christie & Lowe for their contract at Sabine Pass, Tex. Mr. Shaw has also received an order for a 54-ton steam shovel from the Pacific Bridge Co. for use in building the government fortifications at Marrowhead Point.

The Shiffler Bridge Co., of Pittsburgh, Pa., has commenced building the new plant of the Landis Tool Co., at Waynesboro, Pa., and it is expected that it will be ready for work Sept. 1.

The Goodwin Car Co., 96 Fifth avenue, New York, has a train of its new steel 125,000 lb. capacity Goodwin patent gravity dumping cars working daily, handling boulders, rock, gravel and earth, on the excavation work for the new Jerome Park reservoir, near Bedford Park Station, on New York & Harlem Railroad. An opportunity is given to compare the working of the Goodwin cars with the several other cars and methods used in handling the enormous masses of material being taken from the excavations. The cars will remain in exhibition service for the next several days, and particulars regarding exact time and location of exhibition for each special day will be furnished on application to the company. The excavation of this reservoir will probably take about 12 years. It has been going on for over two years.

The new pipe plant of the Chattanooga Foundry & Pipe Works recently built at Chattanooga, Tenn., is described in the *American Machinist*. It has a capacity to consume from 150 to 200 tons of iron a day which is handled several times. Tramways carry the iron and coke to hydraulic hoists which elevate them to the charging floor. The molten iron is carried the length of the building in an electrically driven car on an overhead track, which extends in two directions from the cupolas. There are four casting pits with revolving turrets, designed and patented several years ago by David Giles, President of the company. The drying ovens are at the bottoms of these pits. Tracks run from the pits to the core ovens in the center of the building. The materials are handled by a systematic arrangement of 10-ton electric traveling cranes. The power-house is equipped with two Lane & Bodley Corliss engines which drive generators to supply power for 30 electric motors, ranging in size from 40 H. P. downward.

The American Palace Car Co., of Jersey City, N. J., has increased its capital stock from $10,000 to $1,500,000.

The new machine shop of John E. DuBois, maker of dynamos and electrical machinery, DuBois, Pa., started work Aug. 11. The building is 500 × 800 ft., of iron and brick, with foundry attached.

P. H. Wilhelm, until recently General Agent for the New York Car Coupler Co. in Chicago, has been appointed Western Agent of the Buckeye Malleable Iron & Coupler Co., of Columbus, O.

H. B. Coho & Co., dealers in electrical machinery, St. Paul Building, New York City, have taken the agency for the insulating materials made by the Fiberite Co., of Mechanicsville, N. Y.

Iron and Steel.

The Lebanon Rolling Mill has been absorbed by a new company, the Lebanon Rolling Mill Co. The following are the officers and Directors: President, Samuel E. Light; Treasurer, Richard Meily; Secretary, James H. Roberts; Directors, G. R. Baird, C. W. Nicolls, M. H. Leonard, J. Lansing Mines, Philadelphia; Samuel E. Light and A. Hess, Lebannon.

T. F. Johnson and J. D. Hemphill, of Hollidaysburg, Pa., have decided to remove the Roanoke Rolling Mill Co.'s plant and the Midway Iron Co.'s railroad spike mill, both of which they recently bought, from Roanoke, Va., to Sheffield, Ala. Negotiations are also being made to build a new steel plant at Sheffield.

The Burgess Steel & Iron Works of Portsmouth, O. are building a new blooming mill and a 35-ton basic open-hearth furnace.

The works of the Great Western Tin Plate Co. at Joliet, Ill., has started up after an idleness of six weeks, during which time the plant was remodeled.

The Lucknow forge, near Harrisburg, Pa., which has been idle for the past four years, started up Aug. 16.

The Mary furnace of the Ohio Iron & Steel Co., at Lowellville, O., has been overhauled and will probably be put in blast in a few days. The repairing work was done by the Meehan Boiler & Construction Co. of Lowellvile.

The Carnegie Steel Co., Ltd., Pittsburgh, Pa., is arranging to roll girder rails on its 33-inch mill at the Homestead Steel Works. The Duquesne Steel Works is now running on billets.

A new trial has been refused in the case of the Pittsburgh Iron & Steel Engineering Co. against the National Tube Works Co. brought to recover a balance claimed to be due the plaintiff for building a Bessemer steel plant at McKeesport. The plaintiff recovered a verdict for $76,000.

On Aug. 1 there were six furnaces in blast in the Shenango Valley–Atlantic, Norway and Neshannock at New Castle; Sharon and Stewart at Sharon, and Mabel at Sharpsville. In the Mahoning Valley four furnaces were in blast, these being the Grace of the Brier Hill Iron & Coal Co.; Hubbard, of the Andrews & Hitchcock Iron Co.; Mattie, of the Girard Iron Co., and the Tod of the Youngstown Steel Co. There are seven furnaces in the Mahoning Valley and 10 in the Shenango Valley still out of blast, but it is expected that a greater part of these will be started up before the end of the month.

The Schoen Pressed Steel Co. (of Pittsburgh, Pa.) is doubling the capacity of its plant by the erection of three steel buildings of the following dimensions: 600 × 120 ft., 400 × 120 ft., and 325 × 90 ft. The new buildings will be equipped with machinery of the most modern design, including seven electric cranes, hydraulic presses, punches and riveters. When additions are finished, this company will have about six acres under cover, and capacity for making 500 tons of pressed steel shapes daily.

The Alabama Rolling Mill Co., of Birmingham, Ala. whose plant at Gate City has been idle since July 1, resumed work in all departments Aug. 15.

The Birmingham (Ala.) Rolling Mill Co. resumed work in its finishing departments Aug. 15.

For the first time since 1893 all of the departments of the Vesuvius Mill, of Moorhead Bro. & Co., of Sharpsburg, Pa., are working. The plate mill is turning out 120 tons of finished iron daily.

The Olney steel mill of the Reading (Pa.) Iron Co. resumed work in all departments Aug. 16, after an idleness of several months. The puddlers returned to work at $2.40 a ton instead of $2.70 as heretofore. All the departments of the company are now at work.

An average advance of $2 a ton in the price of structural steel was made at the mills in Cleveland, O., early this week, and another advance is looked for.

The Chicago Pressed Steel Co. has leased the Muscatine (Ia.) rolling mills, and will fit them up to make metallic railroad ties. It is expected that the work of making ties will begin Sept. 1.

New Stations and Shops.

The town officials of Sherbrooke, Que., have voted to issue $16,000 in bonds to provide land in East Sherbrooke for new shops for the Quebec Central Railway. According to the terms of agreement the railroad is to build shops to cost not less than $30,000 within three years.

The Louisville & Nashville has decided to build at once the new freight depot at St. Louis, ground for which was bought about a year ago. The building will be 600 ft. long and 50 ft. wide, of wood, with a corrugated iron roof.

The Cleveland Terminal & Valley Railroad has bought land for a new station at the intersection of South Water and Champlain streets, in Cleveland, O. The new building will be about 160 × 80 ft., with a train shed 400 ft. long, and will cost about $125,000.

The New York, New Haven & Hartford is building a new freight station at New Britain and the work is being done by the railroad company. The building will be 300 ft. long and 25 ft. wide, of wood with brick piers, and be finished in about two months.

The contract for furnishing the stone for the new station of the Chicago, Burlington & Quincy, at Omaha, Neb., has been awarded to the Geddis & Servries Stone Co., of Denver, Col. Platte canyon granite will be used. Schall & Co., of Omaha, are building the stone retention wall, which will face Tenth street.

The East Broad Top Railroad will build a new engine-house at Mount Union, Pa., to replace the one destroyed by a storm last week.

The Pittsburgh, Bessemer & Lake Erie has submitted a proposition to the city of Erie, Pa., to the effect that if permitted to postpone the building of a station until next spring it will give bonds to put up one on Twelfth street to cost not less than $8,000.

Interlocking.

The National Switch & Signal Company, Easton, Pa., has closed a contract for two interlocking plants at Fulton, Ill., at the crossing of the Chicago & Northwestern and the Chicago, Burlington & Quincy. One plant has 14 working levers andt he other three. Electric locking is used for the derail switches, green lights on the Chicago & Northwestern for the all-clear indication and the Hansel door lock is used for the smaller tower.

The Standard Railroad Signal Co. is to put in three signal plants for the Nassau Electric Railroad of Brooklyn, N. Y.; one of 16 levers at Van Sicklen station; one of 16 at Neptune avenue, and one of 6 at Surf avenue.

M. C. B. Standards.

The letter ballot which closed Aug. 2, 1897, resulted in the adoption of all the questions submitted. The details of these were given at considerable length in our issue of July 16, p. 502. In brief the vote was on: The pocket strap; Details for buffer blocks and buffer block location; Uncoupling arrangements for M. C. B. automatic couplers; Instructions for mounting wheels; Box car side and end door fixtures; Arch bars and column bolts; Measurements for cars with steel underframing; Rules for loading logs, poles, bark and long structural materials. The pamphlet of standards and recommended practice, as revised by this vote, will be ready for distribution after Aug. 20.

Pig-Iron Production in July.

In reviewing the pig-iron production for July, the *Iron Age* states that while there have been quite a number of changes in the active blast furnaces the production, on the whole, has varied but little from recent totals. The tendency is toward a larger output. On Aug. 1st, 152 furnaces were in blast with a weekly capacity of 165,378 gross tons, as against 145 furnaces in blast July 1 with a capacity of 164,064 gross tons and against 173 furnaces in blast Aug. 1, 1896, with a capacity of 157,078 gross tons. The highest point reached this year was April 1, when the weekly capacity reached 173,279 gross tons. On Oct. 1 last the capacity was only 112,782 gross tons, with but 130 furnaces in blast. The stocks, sold and unsold, Aug. 1, aggregated 933,958 tons against 1,004,612 tons July 1.

Another British Four-Cylinder Engine.

A four-cylinder locomotive has just been put in service on the Glasgow & South Western Railway. It was built from the designs of Mr. James Manson, Locomotive Superintendent. The engine has a leading truck and four coupled wheels 6 ft. 9½ in. in diameter. It has two outside cylinders of 12½ in. diameter by 24 in. stroke and two inside cylinders of 14½ in. diameter by 26 in. stroke. The outside cylinders are served by balanced slide valves actuated by a rocking shaft, the valve chests being on top of the cylinders; while the inside cylinders have valve chests between them in the usual English way. As the outside cranks are arranged opposite to the inside cranks, they balance each other. The most noteworthy feature in this engine is that although there are four cylinders, there are only the usual two sets of valve gear, eccentrics, etc. The heating surface of the tubes equals 1,094 sq. ft. and that of the firebox 111 sq. ft.; total heating surface, 1,205 sq. ft.; firegrate area, 18 sq. ft.; working pressure, 165 lbs. per sq. in.; weight of engine, 108,640 lbs.; weight of tender, 67,200 lbs.; total, 175,840 lbs. in working order. This engine hauls the Scotch express trains worked by the Glasgow & South Western Company in connection with the Midland Company, but no reports of its performance have yet come to hand.

Bids for Gun Forgings.

Bids were opened at the Navy Department Aug. 14 for forgings for six 6-in. guns, 25 5-in. guns and 15 4 in. guns. Only two firms competed, the Bethlehem Iron Co. bidding 26 cents a pound for the three sizes and the Midvale Steel Co. 26½ cents.

Tube for a 16-In. Gun.

On Aug. 12 a casting for the tube of a 16-in. gun was made by the Bethlehem Iron Co. at South Bethlehem, Pa. It is 19 ft. 6 in. long, octagonal in shape and 74 in. in diameter. More than 100 gross tons of metal were used.

Bids for Disappearing Gun Carriages.

On Aug. 13 bids were opened at the War Department for five disappearing carriages for 12-inch guns to be used in coast defenses. Eight bids were received, the prices ranging from $43,800 each down to $28,560 each, the lowest of which was submitted by the Bethlehem Iron Co., of South Bethlehem, Pa. Other bidders were Wm. Cramp & Sons' Ship & Engine Bldg. Co. and Southwark Foundry & Machine Co., of Philadelphia; Morgan Engineering Co., of Alliance, O.; Weimer Machine Works Co., of Lebanon, Pa.; Brown Hoisting Co., of Cleveland, New Jersey Steel & Iron Co., of Trenton, N. J., and Niles Tool Works, of Hamilton, O.

American Rails for India.

Press despatches state that the *Ironmonger*, of London, has been investigating the recent underbidding of English steel rail makers by American manufacturers, and has learned that an East Indian railroad invited tenders for 7,544 tons of rails, and English rails were offered at an average of $27.50. The American quotation, understood to come from the Maryland Steel Co., was $23 50, delivered at Calcutta. This tender was accepted, together with a tender for accessories, which was also lower. The Secretary of State for India says that further orders for rails for India have been placed in the United States. The Bengal & Nagpur Railroad recently accepted 2,000 tons from an American firm at $23, compared with $27.25, which was the British bid. Lord George Hamilton adds that the quality of the material was tested before acceptance by an official sent to the United States.

American Street Rails for Ireland.

The Johnson Co., of Lorain, O., has received orders for 20,000 tons of rails for street railroads in Ireland. A rate of $3 a ton from the works to Ireland has been obtained for the shipment. The Johnson Co. rolls only girder and T rails for street railroads.

Armor Plate.

Following the example of the William Cramp & Sons' Ship & Engine Building Co., the Union Iron Works of San Francisco has accepted the terms of the Navy Department, and will furnish the diagonal armor plate for the battleship Wisconsin, now building at their yards, at $300 a ton.

The Hudson River Tunnel.

Probably the present owners of the unfinished tunnel across the North River, from Jersey City to New York, have never entirely abandoned hope of completing that project and getting back something on their investment. For a year or two there has been a pretty consistent and definite effort to have the work taken up, and the story now comes that there will be a financial readjustment which will lead to the speedy completion of the tunnel. We do not care to publish now any of the statements that have been made in the daily press, preferring to say something more definite and accurate when the time comes. Mr. C. M. Jacobs is now in London working on this and other projects. His plan, when we last talked with him about the matter, was to finish one tunnel and give up, for the present at least, the idea of a second and parallel tunnel. He would, however, have two tracks in the one tunnel, using specially designed cars and narrow tracks. The tunnel would thus be devoted entirely to local service, as standard-gage cars could not be run through it. The original plan was, it will be remembered, to have two tunnels and one track in each.

THE SCRAP HEAP.

Notes.

The Canadian government has proposed to the government of the United States to join in building a telegraph line to the Klondike goldfields in British America.

The Attorney-General of Texas has begun proceedings to revoke the licenses of express companies doing business in that state. It is said that this action is taken on account of the refusal of the express companies to obey an order of the Commission reducing certain rates.

A press dispatch says that the farmers in Oklahama are now so prosperous (wheat selling at 60 to 65 cents a bushel) that the Chicago, Rock Island & Pacific has asked them to pay the notes which they gave the company for 50,000 bushels of seed wheat furnished to them in 1894.

The employees of the Missouri Pacific have organized an accident insurance company, which has been incorporated under the laws of Kansas. The President is George P. Reed, a locomotive engineer, and among the officers are conductors, brakemen, firemen, bridgemen, etc. It is stated that this action is taken in consequence of the dissatisfaction of the employees with four accident insurance companies hitherto doing business on that road. It is stated that these four companies recently raised their rates.

At Huntington, L. I., the Long Island Railroad has recently commenced delivering freight to consignees free by wagon, most of them being about two miles from the station, but some of the merchants of Huntington own stock in a steamboat running between that town and New York and they tell the railroad that they do not want free cartage. On the other hand they have a decided objection to it. The Traffic Manager of the railroad says that free cartage has been established at Northport and Port Jefferson and will be extended to other stations.

Brooklyn Elevated Cars on the Bridge.

At a meeting of the Board of Directors of the Brooklyn Elevated Railroad, held on Thursday of last week, President Uhlmann was authorized to sign the contracts for the elevated cars to cross the bridge. The elevated and street railroads have until Monday of next week to sign the contracts. For full particulars see last week's issue.

Massachusetts Street Railroad Committee.

Charles Francis Adams, Chairman of the Massachusetts Special Committee to investigate the relations between street railroads and cities and towns, has gone to Europe to gather facts for the committee's report. W. S. Allen, of New Bedford, has been appointed clerk of the committee.

LOCOMOTIVE BUILDING.

The Canadian Pacific has placed an order with the Baldwin Locomotive Works for 10 compound freight engines.

The Kansas City, Pittsburgh & Gulf has bought 10 new 10-wheel locomotives, with 19 × 24-in. cylinders and 64-in. drivers from the Grant Locomotive Works.

The Baldwin Locomotive Works has received an order from the Wiggins Ferry Co., of St. Louis, for two 18 × 24-in. cylinder, 6-wheeled switching locomotives with separate 8-wheeled, sloping-back tenders, similar to locomotives of the same class previously built by Baldwin for that company. These engines are fitted with the American steam brake on driving wheels, United States Metallic Packing Co.'s packing and Detroit lubricators.

CAR BUILDING.

The Illinois Central has placed an order with Pullman's Palace Car Co. for 200 stock cars.

The Cincinnati, New Orleans & Texas Pacific contemplates building some new cars to replace vacant numbers.

The New York, Ontario & Western has placed an order with the Ohio Falls Car Mfg. Co., of Jeffersonville, Ind., for 10 passenger cars. They will be equipped with Gould couplers and vestibules.

The total orders for freight cars for the Kansas City, Pittsburgh & Gulf this year aggregated 1,400, divided as follows: 900 box cars, 350 to the Missouri Car & Foundry Co., St. Louis, 100 of which will have Shickle, Harrison & Howard trucks and 250 American steel trucks; 250 to the Barney & Smith Car Co., Dayton, O., to have American trucks and Security car doors (illustrated in our last issue), and 300 with Pullman's Palace Car Co., Chicago, to have the American steel bolsters; and 400 coal and 100 flat cars with Pullman's Palace Car Co., the former to have Cloud steel trucks.

BRIDGE BUILDING.

Bellaire, O.—It is reported that bids have been asked for the proposed toll bridge over the Ohio River, between Bellaire and Benwood, W. Va. The bridge will be about 525 ft. long, and is expected to cost about $500,000.

Canton, Ill.—J. M. Savill & Sons, of Canton, have the contract for a 40-ft. steel highway bridge over the west branch of Copperas Creek, for $780.

Chambersburg, Pa.—The contract for two iron bridges, to be built by Franklin County, has been given to Nelson & Buchanan, of Chambersburg. One bridge will be at Mowerville, Lurgan Township, and will be 50 ft. long; the other, which will be 60 ft. long, will be at West's Mills.

Colfax, Wash.—The Whitman County Commissioners will receive bids until Sept. 7 for building three 40-ft. bridges, each with an 18-ft. roadway, in Whitman County. The bids should be addressed to John Tobin, County Auditor.

Hagerstown, Md.—The County Commissioners have given the West Virginia Bridge Co., of Charlestown, W. Va., the contract for an iron bridge over the Little Pool, near Millstone, for $690. The work is to be finished by Oct. 10.

Hartford, Conn.—The following bids have been received by William E. Cone, Vice-President of the Board of Street Commissioners, for a masonry bridge over Park River at Park street: P. H. Harrison & Sons, Hartford, $29,400; J. P. Falt & Co., Springfield, Mass., $37,940; Hartford Paving & Construction Co., $34,163; F. T. Ley & Co., Springfield, Mass., $28,400; Charles W. Blake lee & Sons, New Haven, Conn., $24,835.

Hartford, Ky.—The contract for a suspension bridge 175 ft. long, across Rough River at this place, has been given the Wrought Iron Bridge Co., of Canton, O., for $6,675.

Idaho City, Idaho.—Bids for a bridge over Shafer Creek are asked by the Boise County Commissioners until Sept. 13. W. F. Connaughton is County Clerk.

Kent County, Md.—The Kent County Commissioners have contracted with the Wrought Iron Bridge Co., of Canton, O., for a new iron bridge at Urieville Mill, to cost $649.

Louisville & Nashville.—The Louisville & Nashville Railroad has recently placed orders with the Louisville Bridge & Iron Co. for eight bridges and two coal trestles. The Carnegie mills are furnishing the material. The same road has also contracted with the Pencoyd Bridge Co. for one bridge.

Newark, N. J.—The contract for a bridge over the Passaic River at Two Bridges has been given by the Joint Committee of Freeholders, of Newark, to the Canton Bridge Co., of Canton, O., for $2,750.

Philadelphia, Pa.—Messrs. Jutte, Foley & Co., who have the contract for the masonry work, substructure, abutments and retaining walls for the new swing bridge over the Schuylkill at Gray's Ferry, began work Aug. 10. The bridge will be 234 ft. above the old Philadelphia, Wilmington & Baltimore Railroad Bridge. It will be of steel and will have 22 ft. head room. There will be 26 piers, five of which will be river piers. The draw span will be 229 ft. long, and when open will leave two 75-ft. clear channels. The total length of the bridge will be 1,869 ft., and the width 56 ft.

Director of Public Works Thompson has given the contract to Charles A. Porter for the bridge to be built in connection with abolishing the grade crossing of the Philadelphia & Trenton Railroad at Rhawn street, Philadelphia.

Rochester, N. Y.—The city is making a contract with the New York Central and the Buffalo, Rochester & Pittsburgh railroads for the depression of Saxton street, so as to have it run beneath the tracks.

Wayland, Mass.—The contract for rebuilding the canal bridge over the Sudbury River, at this place, has been given to Holbrook, Cabot & Daly for $2,924.

Wilmington, Del.—The contract for the iron work for the bridges to be built by the Baltimore & Ohio, in connection with the abolishing of grade crossings in Wilmington, has been given to the Pencoyd Iron Works. There will be two bridges, one at Pennsylvania avenue, consisting of a double track through plate girder, clear span 62 ft., and one at Fourteenth street, consisting of a four-track through-plate girder, clear span 63.24 ft.

Both of these bridges will be built on a skew, and will have a curved alignment. All masonry work will be done by Stewart & Keenan, contractors.

RAILROAD LAW—RECENT DECISIONS.

The Appellate Division of the New York Supreme Court by a majority of one, two judges dissenting, holds that a guaranty by which a railroad corporation guarantees to the holder of a bond issued by another railroad corporation "the punctual payment of the principal and interest thereof, when and as the same shall become due and payable," is not available to the owner of a coupon which has been cut off and transferred to him by the holder of the bond so guaranteed. After such a severance and transfer the coupon becomes an independent obligation of the company which issued the bond, and is enforceable against it by the transferee, but not against the guarantor, as the guaranty is exclusively a contract with the holder of the bond, and does not attach to or accompany the coupon (decided in the App. Div. Sup. Ct., April, 1897).[1]

In New York a standard railroad company placed a crossing over the tracks of a street railroad without its consent, and without having begun condemnation proceedings for that purpose. The crossing having been removed by the street railroad company, it was replaced by the other company, and an injunction was obtained forbidding the street railroad to interfere with it further. This injunction was vacated on the ground that the action of the standard railroad company was illegal. In an action subsequently brought by the city where the crossing in question was situated, to restrain both companies from obstructing a public street at the crossing and creating a nuisance there, it is held, that since a street railroad company may lawfully protect its own property, and may resist any unlawful invasion of its rights, the injunction was improperly granted as to it (decided in App. Div. Sup Ct., May 18, 1897).[2]

In New York, in a case where a lease reserved a specified sum as rent for a period of years, and further provided that at the end of such period the amount of rent to be paid for a further period should be determined by appraisers, it is held, that where an elevated railroad was built in front of the leased premises, after the execution of the lease and before the appraisement, the lessor was entitled to recover damages against the railroad company for any diminution in the amount at which, but for the occupation of the street by the railroad, the appraisers would have fixed the rent (decided in App. Div. Sup. Ct., May, 1897).[3]

In New York evidence that a child about three years old walked from the curb of the sidewalk to the track of a street railroad, reaching it when the horse drawing an approaching car at the rate of 12 miles an hour was still 10 ft. away from her, and that, although there was nothing to obstruct the driver's view and the car might have been stopped within a distance of 12 ft., the child was knocked down and injured, is sufficient proof to support a verdict against the railroad company on the ground that the negligence of the driver in not looking in the direction in which he was driving was the cause of the injury (decided in App. Div. Sup. Ct., May, 1897).[4]

In New York a railroad company issued a ticket subject to a contract which provided "that each unattached coupon of this ticket shall entitle the purchaser, a member of his or her immediate family, or a visitor to, or a servant therein" to one continuous passage in either direction between the stations named thereon, and also provided that it should be forfeited if presented for passage by a person not indicated on its face. Such a ticket was used by a person who was not a member of the family of the purchaser, or employed as a servant therein, nor a guest, but a neighbor having social relations with the family, and in the habit of coming to see its members from time to time. While alighting at a station she was thrown down by a movement of the train, and her thigh was broken. In an action to recover damages for this injury, it is held that although the plaintiff was not one of the class entitled to use the ticket, the meaning of the term "visitor" being confined to persons visiting the family at the time and becoming temporarily members thereof as guests, if she used it in the honest belief that she was entitled to use it, the railroad company was liable for the injury, if occasioned by its negligence (decided in App. Div. Sup. Ct., May, 1897).[6] It is to be observed that two judges dissented from that part of this decision which defines and limits the meaning of the word "visitor" as applied to the ticket in question.

In Kentucky it is held in an action to recover for the appropriation of the plaintiff's alley by a railroad company for the purposes of its railroad, that the plaintiff was entitled to recover for injury done to his premises abutting on the alley as well as for the value of the part of the alley actually taken (decided in the Ct. of App. April, 1897).[7]

It is held that under the Texas statute, which provides that any person engaged in the service of a railroad corporation, who is "entrusted with the authority of superintendence, command or control over other persons" in such service, is not a fellow-servant with such other employees: a conductor, who has general superintendence of the movements of a train and command of the train crew, except in certain cases where the safety of the train is involved, in which cases the engineer is authorized to act on his own judgment, is not a fellow-servant with the engineer, even when the latter, acting on his own responsibility, has stopped the train to repair his engine. It follows that the rule exempting a corporation from liability for injuries sustained by one of its servants through the negligent act of a fellow-servant did not apply in this case, and that the company was responsible for the negligence of the conductor in failing to flag a train following, which resulted in an injury to the engineer (decided in Sup. Ct., April, 1897).[8]

The rule governing this case is different in West Virginia, where plaintiff, a brakeman engaged in coupling cars, was injured by reason of a negligent order given by the conductor of his train. In an action to recover damages from the railroad company for the injury, it is held, that if the conductor, when the particular act in which his negligence occurred was not acting in the exercise of his power of superintendence, but in the line of the duty of one who would be a fellow-servant with the injured employee, he was such a fellow-servant and the company was not liable for his negligence (decided in the Sup. Ct., April, 1897).[9]

An act of the Texas Legislature imposing a penalty upon a railroad company for a refusal to deliver freight to the owner or consignee on payment or tender of the freight charges due, as shown by the bill of lading, is in conflict with an act of Congress regulating commerce [10], and, as to interstate shipments, cannot be enforced (decided in Ct. of App., March, 1897).[11]

In Texas, it is held that where a railroad company, with knowledge that an applicant for cars had contracted to sell and deliver freight, had failed without reasonable excuse to furnish him cars for its shipment, by reason of which the contract was annulled, it is liable for the profits he would have made if the contract had been carried out. It is a sufficient compliance with the provision of the statute requiring an applicant for cars, in order to subject the company to liability for the penalty provided for failure to furnish them, to deposit "with the agent" of the company at the time of making the application one-fourth of the amount of the freight charges, if he makes a tender of the amount to a station agent of the company on the morning following the sending of a written application to the superintendent or person in charge of transportation, to whom the application is required by the statute to be made (decided in the Ct. of Appeals March, 1897).[12]

In Arkansas, where freight is shipped over connecting lines of railroad, and a contract for its shipment is made with the initial carrier, providing that the liability as common carriers of both the railroad companies over which the freight is shipped shall terminate on its arrival at the place to which it is consigned, and that afterward they shall be liable as warehousemen only, such contract inures to the benefit of the connecting carrier, and the consignor cannot recover against it if the freight is destroyed by fire while in its station (decided in the Sup. Ct., May, 1897).[13]

In Texas it is decided that the statute of that state which requires railroad companies to redeem unused tickets on due presentation, and imposes a penalty for a failure to redeem them, is limited in its application by the provisions of the Interstate Commerce Act to tickets issued by railroads in the state for passage only from and to points within the state (decided in the Ct. of Appeals, April, 1897).[14]

It is held that the Arkansas statute which requires corporations and persons operating railroads to pay their employees on the day of their discharge the unpaid wages then due, at the rate contracted for, and as a penalty for non-payment, provides that the wages of the employee shall continue at the same rate until paid, does not deny to railroad corporation affected thereby the "equal protection of the laws" secured to them by the 14th amendment to the Constitution of the United States, and is valid as to such corporations (decided in the Sup. Ct., May, 1897).[15]

[1] Clokey v. Evansville & H., 16 App. Div., 304.
[2] City of Kingston v. Col. Cit. T., 17 App. Div., 274.
[3] Winthrop v. Manhattan, 17 App. Div., 509.
[4] Nugent v. Metropolitan, 17 App. Div., 582.
[5] Hennessy v. N. C. 17 App. Div., 162.
[6] Odell v. N. Y. C. & H. R. R., 18 App. Div., 12.
[7] Covington & C. El. v. Ruffra, 40 S. W., 383.
[8] Culpepper v. International & G. N., 40 S. W., 386.
[9] Jackson v. N. & W., 27 S. E., 278.
[10] Feb. 4, 1887.
[11] Houston, E. & W. T., v. Peters, 40 S. W., 429.
[12] Houston, E., & W. T., v. Campbell, 40 S. W., 431.
[13] K. C., Ft. S. & M. v. Sharp, 40 S. W., 781.
[14] M., K. & T., of Texas, v. Fookes, 40 S. W., 858.
[15] St. L., I., M. & S. v. Paul, 40 S. W., 705.

MEETINGS AND ANNOUNCEMENTS.

Dividends.

Dividends on the capital stocks of railroad companies have been declared as follows:

Boston & Maine, $3 per share on preferred stock, payable Sept. 1.

Mexican Northern, quarterly, 1 per cent., payable Sept 2.

North Pennsylvania, quarterly, 2 per cent., payable Aug. 25.

Stockholders' Meetings.

Meetings of the stockholders of railroad companies will be held as follows:

Chicago, Indianapolis & Louisville, annual, for the election of directors and other business, Indianapolis, Ind., Sept. 15.

Chicago, Milwaukee & St. Paul, for the election of directors, Milwaukee, Sept. 15.

Illinois Central, to vote on bond issue, Chicago, Sept. 15.

Kansas City, Pittsburgh & Gulf, to vote on increase of stock, Kansas City, Sept. 9.

Minneapolis & St. Louis, annual, for the election of directors and other business, Minneapolis, Minn., Oct. 5.

New York, Susquehanna & Western, for the election of directors and other business, Jersey City, Sept. 2.

Wabash, annual, for the election of directors, St. Louis, Sept. 14.

Technical Meetings.

Meetings and conventions of railroad associations and technical societies will be held as follows:

The *American Society of Railroad Superintendents* will hold its next meeting at Nashville, Tenn., beginning Sept. 22.

The *American Street Railway Association* will hold its sixteenth annual convention in Convention Hall, Niagara Falls, Oct. 19-22, 1897.

The *Association of Railway Superintendents of Bridges and Buildings* will hold its seventh annual convention at the Brown Palace Hotel, Denver, Col., beginning Oct. 19, 1897.

The *Boston Society of Civil Engineers* meets at 715 Tremont Temple, Boston, on the third Wednesday in each month, at 7:30 p. m.

The *Canadian Society of Civil Engineers* meets at its rooms, 112 Mansfield street, Montreal, P. Q., every alternate Thursday, at 8 p. m.

The *Central Railway Club* meets at the Hotel Iroquois, Buffalo, N. Y., on the second Friday of January, March, May, September and November, at 2 p. m.

The *Civil Engineers' Club of Cleveland* meets in the Case Library Building, Cleveland, O., on the second Tuesday in each month, at 8 p. m. Semi-monthly meetings are held on the fourth Tuesday of each month.

The *Engineers' and Architects' Association of Southern California* meets each third Wednesday of the month in the Hall of the Chamber of Commerce, Los Angeles, Cal.

The *Engineers and Architects Club of Louisville* meets in the Norton Building, Fourth avenue and Jefferson street, on the second Thursday each month at 8 p. m.

The *Engineers' Club of Cincinnati* meets at the rooms of the Literary Club, No. 25 East Eighth street, Cincinnati, O., on the third Thursday in each month, at 7:30 p. m. Address P. O. Box 333.

The *Engineers' Club of Minneapolis* meets in the Public Library Building, Minneapolis, Minn., on the first Thursday in each month.

The *Engineers' Club of St. Louis* meets in the Missouri Historical Society Building, corner Sixteenth street and Lucas place, St. Louis, on the first and third Wednesdays in each month.

The *Engineers' Society of Western Pennsylvania* meets at 410 Penn avenue, Pittsburgh, Pa., on the third Tuesday in each month, at 7:30 p. m.

The *Master Car and Locomotive Painters' Association* will hold its annual convention at Old Point Comfort, Va., Sept. 8, 1897. Robert McKeon, Secretary, Kent, O.

The *Montana Society of Civil Engineers* meets at Helena, Mont., on the third Saturday in each month, at 7.30 p. m.

The *National Railroad Master Blacksmiths' Association* will hold its annual convention at Chicago Sept. 7.

The *New England Roadmasters' Association* will hold its annual convention at the Revere House, Boston, Mass., Aug. 18 and 19, 1897.

The *North-West Railway Club* meets on the first Tuesday after the second Monday in each month, at 8 p. m., the place of meeting alternating between the West Hotel, Minneapolis, and the Ryan Hotel, St. Paul.

The *Northwestern Track and Bridge Association* meets at the St. Paul Union Station on the Friday following the second Wednesday of March, June, September and December, at 2.30 p. m.

The *Railway Signalling Club* will meet on the second Tuesday of the months of January, March, May, September and November, in Chicago.

The *Road Masters' Association of America* will hold its annual meeting at Old Point Comfort, Va., Sept. 14 16, 1897.

The *St. Louis Railway Club* holds its regular meeting on the second Friday of each month, at 3 p. m.

The *Southern and Southwestern Railway Club* meets at the Kimball House, Atlanta, Ga., on the third Thursday in January, April, August and November.

The *Technical Society of the Pacific Coast* meets at its rooms in the Academy of Sciences Building, 819 Market street, San Francisco, Cal., on the first Friday in each month, at 8 p. m.

The *Traveling Engineers' Association* will hold its annual convention at Chicago Sept. 14.

Roadmasters' Association of America.

The Fifteenth Annual Convention of this Association will be held at the Chamberlain Hotel, Old Point Comfort, Va., Sept. 14, 15 and 16, 1897. Committees have been appointed to report on the following subjects:

Best Method of Preventing Creeping of Rails, F. J. Allen, Chairman, C., B. & Q. R. R., Aurora, Ill.

Tie Plates, the Benefits and Results Obtained from Their Use, E. E. Stone, Chairman, B. & A. R. R., Springfield, Mass.

Track Joints, Results Obtained from Use of Various Devices, C. E. Jones, Chairman, C., B. & Q. R. R., Beardstown, Ill.

Paper—Best Method of Directing and Supervising the Work of Section Foremen: What Reports are Necessary for the Special Information of the Roadmaster to Enable Him to Successfully Direct and Control the Work, H. W. Church, L. S. & M. S. R. R., Englewood, Ill.

Is it More Economical to Put in Ties Out of Face or in Patches? F. R. Coates, Chairman, N. Y., N. H. & H. R. R., Stamford, Conn.

Latest Improvements in Frogs and Switches, W. J. Prindle, Chairman, Pennsylvania Company, Chicago Ill.

To Arrange for Fifteenth Annual Convention, A. M. Hawkins, Chairman, N. & S. R. R., Edenton, N. C.

The reports will be distributed during the meetings.

PERSONAL.

—Mr. Sheldon T. Bent has been appointed General Superintendent of the Interoceanic of Mexico.

—Mr. M. J. Grace, New England Passenger Agent of the Grand Trunk at Portland, Me., has resigned to take effect Sept. 2.

—Mr. Kenzie L. Greene, one of the promoters of the East Broad Top Railroad, died at Orbisonia, Pa., Aug. 4, aged 93 years.

—Mr. Thomas Warren, prominent for many years as a promoter of railroads in Louisiana, died at his home in New Orleans, Aug. 10.

—Mr. F. C. Reilly has been appointed Traveling Freight Agent for the St. Louis & San Francisco, with headquarters at Chicago.

—Mr. W. B. Bradley has resigned as General Freight and Passenger Agent of the Atlanta, Knoxville & Northern, to take effect Sept. 1.

—Mr. James C. Tyrrell has been appointed Traveling Freight Agent of the Missouri Pacific to succeed Mr. Philip Doddridge, resigned.

—Mr. E. M. Winstead has been appointed Traveling Freight Agent for the St. Louis & San Francisco, with headquarters at Dallas, Tex.

—Mr. F. V. Parker has been appointed General Freight and Passenger Agent of the recently consolidated Omaha, Kansas City & Eastern.

—Mr. J. S. Adsit has been appointed Contracting Freight Agent for the Chicago, Milwaukee & St. Paul, with headquarters at Kansas City, Mo.

—Mr. Joseph Herrin has resigned as Superintendent of the Western of Alabama, and will be succeeded by Assistant Superintendent P. T. Downs.

—Mr. John Clark has resigned as Master Mechanic of the Northern Ohio, part of the Lake Erie & Western, and his successor is Mr. David Anderson.

—Mr. C. E. Swan, formerly Chief Clerk to the General Claim Agent of the Northern Pacific, has been promoted to the position of Traveling Claim Agent.

—Mr. J. T. Blair has resigned as General Agent of the Pittsburgh, Bessemer & Lake Erie, to become General Manager of the Colorado & Northwestern.

—Mr. George Girard Tunnell, Ph. D., has been appointed Statistician in charge of the Bureau of Lake Commerce recently established at Chicago.

—Mr. A. J. Shank, at one time General Freight and Passenger Agent of the Pittsburgh & Connellsville, died at his home in Braddock, Pa., Aug. 11.

—Mr. M. G. Sylvander has been appointed General Freight and Passenger Agent of the Mt. Jewett, Kinzua & Ritterville, to succeed Mr. W. B. Bradley, resigned.

—Mr. M. G. McNamara has been appointed Traveling Passenger Agent of the Continental Line and Central States Despatch with headquarters at Lewisburg, Ky.

—Mr. J. W. Farley has been appointed Commercial Agent of the St. Louis Southwestern, with headquarters at Greenville, Tex., to succeed Mr. J. D. Bone transferred.

—Mr. David T. Bound has been appointed General Superintendent and Purchasing Agent of the Wilkes-Barre & Northern at Wilkes-Barre, Pa., to succeed Mr. A. A. Holbrook, resigned.

—Mr. J. D. Bone, formerly Commercial Agent of the St. Louis Southwestern, at Greenville, Tex., has been transferred to a similar position at Houston, Tex., to succeed Mr. J. W. Tate, resigned.

—Mr. C. A. Ralston has been appointed Superintendent and General Freight and Passenger Agent of the Dayton, Lebanon & Cincinnati, with headquarters at Lebanon, O., to succeed Mr. M. H. Cook.

—Mr. E. Gerber, who for a number of years has been associated with Mr. George S. Morison, Civil Engineer, Chicago, has accepted the position of Chief Engineer of the Lassig Bridge & Iron Works, Chicago.

—Mr. Philip Doddridge has resigned as Traveling Freight Agent of the Missouri Pacific to accept the position of Contracting Freight Agent of the Denver & Rio Grande, with headquarters at St. Louis.

Mr. A. E. Robbins, formerly General Superintendent of the Columbus, Hocking Valley & Toledo, has been appointed Division Superintendent of the Buffalo Division of the Wabash, with jurisdiction between Detroit and Buffalo.

—Mr. H. T. Porter, formerly General Roadmaster of the Toledo, St. Louis & Kansas City, has been appointed Chief Engineer of the Chicago, Peoria & St. Louis, with headquarters at Springfield, Ill., to succeed Mr. H. C. Landon, resigned.

—Mr. E. W. Fields, until recently General Freight and Passenger Agent of the Waco & Northwestern, has been appointed General Freight and Passenger Agent of the Atlanta, Knoxville & Northern, with headquarters at Marietta, Ga., to succeed Mr. W. B. Bradley, resigned.

—Mr. H. C. Dinkins, formerly General Agent of the Atchison, Topeka & Santa Fe, at City of Mexico, has been appointed General Agent of the International & Great Northern, St. Louis, Iron Mountain & Southern and the Missouri Pacific, with headquarters in the same city.

—Mr. Arthur White, Division Freight Agent of the Grand Trunk at Toronto for a number of years, has accepted the position of General Manager of the National Dispatch Fast Freight line. He is succeeded by Mr. James Dalrymple, for several years private secretary to General Traffic Manager George B. Reeve of the Grand Trunk.

—The resignation of Mr. Edwin W. Winter as President of the Northern Pacific has been accepted, to take effect Aug. 31. Mr. Winter entered this position about a year ago on the reorganization of the road. He entered railroad service in 1867 in the construction department of the Union Pacific. He was General Claim Agent of the Chicago & Northwestern for three years following 1873. For the next 20 years he was with the Chicago, St. Paul, Minneapolis & Omaha, as General Superintendent, as Assistant to the President, and finally from 1885 as General Manager, which position he left to accept that of President of the Northern Pacific.

—Mr. Chas. S. Mellen, the new President of the Northern Pacific, has been in railroad service nearly 30 years. He began as clerk in the cashier's office of the Northern New Hampshire. In 1880 he was made Assistant to the Manager of the Boston & Lowell, later becoming its Auditor and Superintendent and, in 1884, its General Superintendent. Four years later he was made General Purchasing Agent of the Union Pacific, remaining with that road until 1892, after being promoted to the position of General Traffic Manager. He then became General Manager of the New York & New England, at Boston. For the past five years he has been Vice-President of the New York, New Haven & Hartford.

—Chevalier Franz von Rhiza, long esteemed as one of the great authorities on tunnel building, died at Semmering, Austria, June 22, aged 66. He was born in Bohemia, educated at the Prague Polytechnic School, and saw his first service as an engineer on the Semmering Railroad in 1851. For several years his work was chiefly on new railroads with many tunnels, and afterward he became a tunnel contractor, and still later the engineer of coal mines. He introduced new methods in tunnel construction, which were quite generally adopted. In 1874 he became Chief Engineer in the Austrian Ministry of Commerce; in 1876 Professor of Railroad and Tunnel Construction in the Vienna Technical High School, which place he held till his death. In 1871 he published his widely known work on the "Art of Building Tunnels." Later he published a work on railroad construction in three volumes, and he was an indefatigable investigator of engineering questions down to his death.

—Col. James Moore died at his home in Elizabeth, N. J., on the night of Aug. 14, at the age of 84. Colonel Moore was well known to the older generation of engineers, but had not been very active for many years, and had lived in considerable seclusion, and consequently was hardly known to the younger men of the profession. He entered the profession by the old way, that is, as chainman with a party surveying the line of the old Philadelphia & Columbia Railroad. This was in 1828 when he was 15 years old. From that year until the end of his life he was connected with railroads in some capacity. He was engaged as engineer on many of the earliest railroads built in the United States, and in 1835 became Chief Engineer of the Elizabethtown & Somerville Railroad, which became eventually the Central Railroad of New Jersey. Under Colonel Moore's direction the main line and nearly all of the branches of the present Central of New Jersey system were built. He served also as Chief Engineer of the Morris Canal, as locating engineer for the Vermont Central, as General Superintendent of the Vermont Central, as General Superintendent of the Michigan Southern & Northern Indiana, and again as Chief Engineer of the Central of New Jersey; and also as General Superintendent of that road. After he retired from the responsible charge of work he became Consulting Engineer for the Central Railroad of New Jersey, which position he held until his death.

ELECTIONS AND APPOINTMENTS.

Chicago Great Western.—At a meeting of the Board of Directors held at St. Paul, Minn., Aug. 11, Maurice S. Wormser, of New York, was elected Director to succeed H. A. Gardner, of Chicago, resigned.

Mansfield Short Line.—The officers and Directors of this road, whose incorporation is noted in another column, are as follows: President, C. W. French; Vice-President, W. S. Cappeler; Secretary, E. H. Zurhorst; Treasurer, S. A. Jennings; General Counsel, C. E. McBride. Directors: C. E. McBride, S. A. Jennings, C. W. French, W. S. Cappeler, Henry C. Hedges, Mansfield; William Thornburg, Shelby, and E. H. Zurhorst, Sandusky.

Northern Pacific.—At a meeting of the Directors, held in New York City Aug. 12, Chas. S. Mellen was elected President and a Director of the road, to succeed Edwin W. Winters, whose resignation has been before the Board since April 29. Ex-Secretary Daniel S. Lamont was elected Vice-President. They will assume the duties of their new positions Sept. 1.

Fitchburg.—At a meeting of the Board of Directors, held at Boston Aug. 12, Robert Codman was elected Chairman of the Board of Directors and Acting President, to fill the vacancies caused by the death of President Marcy. Joseph W. Richards was elected Auditor, to succeed C. S. Anthony, deceased.

Richmond, Petersburg & Carolina.—At an adjourned meeting of the stockholders held at Petersburg, Va., Aug. 12, the following officers and Directors were elected: President, DeWitt Smith; Vice-President and General Manager, General James S. Negley. Directors: DeWitt Smith, General James S. Negley, Robert Johnston Mooney, New York; Chas. E. Johnston, Raleigh, N. C., and W. R. McKenny, Petersburg.

RAILROAD CONSTRUCTION, Incorporations, Surveys, Etc.

Atlantic Coast Line.—A charter has been granted in North Carolina to build a road from Elrod, in Robeson County, N. C., southeast about 24 miles to Hub, the southern terminus of the Wilmington & Conway, a part of the Atlantic Coast Line. It is understood that this project is approved by the Atlantic Coast Line.

Baltimore & Ohio.—The new 85-lb. rail is being delivered at the rate of 5,000 tons a month. As fast as it comes it is being laid, and if the weather continues good at least 20 000 tons of it will be in the track by Christmas. About 10,000 tons of new steel will be laid on the lines west of the Ohio River this fall, if weather permits.

Beech Creek.—It is reported that grading is begun on the extension of this road southwest up Curry Run from Mahaffey, Pa. The line already built extends from Patton, Pa., southwest about 25 miles to Mahaffey. Irvin & Mitchell are doing the work.

Delaware & Hudson.—This company is reported to have engineers surveying for an extension from Carbondale, Pa., north 37 miles to Lanesborough. For several years the company has leased the Jefferson branch tracks of the Erie between the two points, but this lease will soon expire.

Durham & Charlotte.—An extension of this road, formerly known as the Glendon & Gulf, is being built from Glendon, southwest toward Charlotte. This road has been operated for several years from Gulf, southwest to Glendon, 9.3 miles. Trains now run to Johnson City, about 14 miles from Gulf. A bridge has been built over Deep River at Glendon. Frank D. Jones, of Glendon, is Superintendent.

Evansville & Richmond.—A force of men was put at work on this road Aug. 5. Operations were entirely suspended in March on account of the heavy damages from floods and the road has not since been operated. It was chartered in 1888 to extend from Elnora to Richmond, Ind., 175 miles. Of this there have been built 101 miles, from Elnora to Westport.

Kansas City & Eastern.—This company has been incorporated in Missouri with a capital stock of $50,000 to build a line from Kansas City south five miles to Leds. The incorporators are George Hoffman, Charles B. Adams, John Hofmann, Henry Pfeiffer and B. F. Robinson.

Kansas City, Pittsburgh & Gulf.—Track-laying is being pushed at the rate of about a mile a day on the section between Beaumont and De Quincy, about 40 miles. It is expected that this final section of the road will be completed not later than Sept. 20, which will give direct connection with Port Arthur. Trains now run to Lake Charles, thence over the tracks of the Southern Pacific to Beaumont, thence by the company's own line to Port Arthur.

Lexington & Northwestern.—This company has been chartered, with a capital stock of $100,000, to build a railroad from Lexington, Okla., northwest about 14 miles to Norman, a point on the Atchison, Topeka & Santa Fe. Among the incorporators are A. D. Goodenough, F. W. Hawes, V. E. Ray and W. T. James.

Long Island.—Surveys for the proposed extension of this road from its present north shore terminus at Great Neck, L. I., to Port Washington, 4½ miles, are being pushed forward rapidly under the supervision of William A. Cattell, engineer in charge. Plans are being drawn and specifications prepared to submit to bidders. It is hoped that all contracts will be closed before Sept. 1.

Mansfield Short Line.—This company has been incorporated to build a line in Richland County, O., from Lucas, northwest to Shelby, about 20 miles, by way of Mansfield. The names of the Directors and officers will be found in another column.

Mexican National.—About 500 men are at work on the extension of this road from Patzcuaro west to Uruapan, 86 km. (54 miles). About 17 km of roadbed have been completed and rails have been laid on 10 km.

New Roads.—J. H. Heany, who was appointed by Governor Jones, of Arkansas, as Chief Engineer under the Bush bill providing for new lines of state railroad to be built by convict labor, has submitted an estimate of the engineering part of the cost of engineering a road from Little Rock northwest to the Missouri state line, near White River. He estimates the distance approximately at 160 miles, and that the cost of the first surveys should not exceed $600. The probable cost of location surveys he places at $16,000. For engineering work in connection with the construction, including the office and field equipments, he places the estimate at $60,000.

Paragould Southeastern.—This company has filed amended articles of incorporation with the Secretary of State in Missouri for an increase of its capital stock from $50,000 to $134,000, and providing for the proposed extension from Cardwell, Mo., noted in this column Aug. 6.

Pennsylvania.—The first passenger train was run over the Scalp Level extension of this road, Aug. 8. The branch extends from Lovett, in Cambria County, southwest, 8 miles to Scalp Level, a point on the Baltimore & Ohio. The contract for the work was let in March.

Quakertown & Easton.—The first train over this road was run Aug. 12 from Quakertown, Pa., to Richlandtown. The road as projected will extend from Quakertown northeast 22 miles to Easton.

San Antonio & Gulf.—The extension of 12 miles from Sutherland Springs to Stockdale is completed, and a regular schedule of trains between San Antonio and Stockdale, 40 miles, was put into effect Aug. 14. President George Dullnig has gone to New York to negotiate for capital to extend the road to Galveston, a distance of about 160 miles.

Sierra, Cal.—It is reported that the track has been laid and that trains are running from Oakdale to Crimea House, a distance of 32½ miles. The road is graded to Montezuma, 4½ miles further. As projected the line is to extend from Oakdale, a point on the Southern Pacific, northeast to Sonora, and thence northwest to Angel's Camp. A branch will also be built from Chinese Camp southwest to Coulterville, in Mariposa County.

Sioux City & Omaha.—This company has been incorporated in Nebraska to build a line between Sioux City, Ia., and Omaha, Neb., about 90 miles. Among the incorporators are J. R. Anderson and B. F. Fuller, Tekamah, Neb., and Mitchell Vincent, of Onawa, Ia. The proposed route runs across the Winnebago and Omaha Indian reservations, passing through Decatur and Tekamah, with a bridge over the Missouri River at Onawa.

Electric Railroad Construction.

Ashland, Pa.—It is announced that the extension of the electric railroad between Centralia and Ashland is now assured and that the work will be completed in nine months. The road is to be run independent of the lines of the Schuylkill Traction Co.

Chattanooga, Tenn.—The Chattanooga Electric Railway Co. will rebuild its Alton Park line for the entire length of Cowart street, at an estimated cost of $1,000.

Columbus, O.—The Napoleon & Terrace Park Railroad Co., of Henry County, has been incorporated with a capital stock of $10.000, by E. M. Himer, A. J. Richter and others, to build an electric road between the main line of the Detroit & Lima Northern from Napoleon to Terrace Park.

Fallsburgh, N. Y.—The Fallsburgh & Monticello Railroad Co. has been granted permission to build an electric road from the station of the New York, Ontario & Western, at Fallsburgh, to the Port Jervis & New York Railroad station, at Monticello.

Knoxville, Tenn.—H. B. Krotter has received the contract for building the extension of the Knoxville Street Railroad to Galesburg.

Lowell, Mass.—Surveys have been completed by the Lowell & Suburban Street Railway Co., for an electric road in Lowell. The capital has all been secured. Mr. P. F. Sullivan is general manager of the road.

Mansfield, O.—The New London & Londonville Electric Railroad Co. has been organized by J. R. Swartz, Ashland; S. J. McCready, New London; E. J. Best, Cleveland, and others. H. A. Thomas has been elected President. H. A. Mykrantz, of Ashland, Vice-President; F. N. Patterson Secretary, and M. A. Ulman, Treasurer.

Milwaukee, Wis.—Besides the plans which have been completed for the absorption of the Waukesha Beach Electric line by the Milwaukee Electric Railway & Light Co. it is proposed to build an extension from the beach to Oconomowoc and to build a large central station in Milwaukee, and also to complete the electric line from Milwaukee to White Fish Bay. These improvements will cost nearly $1,000,000.

Morganton, N. C.—The Morganton & Blowing Rock Electric Railroad, recently organized, will build a road about 37 miles in length between the places mentioned in the title. The promoters of the enterprise state a Boston capitalist has informed them he will take $50,000 of the $300,000 of stock it is proposed to raise to build the same.

Napoleon, O.—The Napoleon & Terrace Park Railroad Co. has been incorporated with $10,000 capital stock to build an electric road between Terrace Park and Napoleon.

New York.—On Aug. 2 work was begun on the Madison Avenue line at Fifty-ninth street in changing the motive power to electricity. General Collis has also given a permit to the Metropolitan Traction Co. to tear up the streets for the electric conduit on Twenty-third and Fifty-ninth street crosstown lines.

Norwalk, Conn.—The Westport & Saugatuck Street Railway Co. has petitioned the Council for permission to extend its lines through a number of streets in Norwalk.

Oneonta, N. Y.—The Oneonta & Otsego Valley Railroad Co. has been granted permission by the Railroad Commissioners to operate its line with electricity.

Orange, N. J.—The Council has passed the grade-crossing ordinance of the South Orange & Maplewood Street Railway Co., which will permit that road to cross the tracks of the Metropolitan Traction Co. It is proposed to do a considerable freight business on the new road, which is now being built.

Paterson, N. J.—The Union Traction Co. has extended its Greenwood Lake-Rutherford line to Woodbridge, and is running cars regularly from Arlington through Lindhurst, Rutherford and Carlstadt. The road is being double-tracked in some places.

Pottstown, Pa.—Work will soon be begun on the extension of the Ringing Rock Electric Railway to New Hanover. It is proposed to extend the line to Boyertown at some future time.

Santa Ana, Cal.—The Santa Ana & Newport Railway Co. has been incorporated, with a capital stock of $500,000, and the directors include Joseph McFadden and E. M. Smiley.

Graniteville, Staten Island, N. Y.—The Staten Island Electric Railroad has laid a single-track line from the Morning Star road, in Graniteville, to Buns Head.

Tacoma, Wash.—An ordinance has been introduced into the City Council to grant Frank C. Ross the right to build a single or double track standard gage road along some of the principal streets in Tacoma.

Washington, D. C.—The Washington *Star* states that the Columbia & Maryland Railroad Co. are about to resume work on the road between Washington and Baltimore. The Court has been asked to discharge the Receivers and grant the stockholders permission to assume full control of the franchise. The reorganization plan proposes the execution of two mortgages, one to cover an issue of $3,000,000 of 5 per cent. 40-year bonds and the other a second mortgage of $3,000,000 to cover an issue of 45-year 5 per cent. bonds. The first mortgage will be devoted to the completion of the road and the second mortgage bonds will be used to cover

the amount of money that has been spent already on the work. The road has been partly completed and is in operation.

Waynesboro, Pa.—A public meeting will be held Aug. 21 for the purpose of discussing the matter of giving the proposed Blue Ridge & Waynesboro Electric line a right of way over the public highway in the township.

Wilmington, Del.—The Wilmington & Brandywine Springs Electric Railway Co. has asked permission to allow its line to enter Wilmington, and the contract for construction of the road has been awarded to Vandegrift & Jacobs, of Philadelphia.

GENERAL RAILROAD NEWS.

Blue Ridge & Atlantic.—No bids were offered for this road, which was put up for sale at Clarksville, Ga., Aug. 7, under decree of the United States Court. The upset price was fixed at $40,000, and the purchaser is bound to assume obligations to the amount of $35,000. Attempts will be made to obtain a decree for a lower upset price. The road is 21 miles long, extending from Cornelia to Fullulah Falls, Ga. Mr. W. V. Lauraine is the Receiver.

Boston & Maine.—Earnings of this road for the three months and the 12 months ended June 30 were as follows:

Three Months:	1897.	1896.	Inc. or Dec.
Gross earn	$4,904,670	$5,028,021	D. $123,351
Oper. expen	3,408,760	3,576,502	D. 167,742
Net earn	$1,495,910	$1,451,519	I. $44,391
Other income	236,242	181,568	I. 54,674
Total income	$1,732,152	$1,633,087	I. $99,065
Fixed charges	1,348,750	1,317,424	I. 31,326
Surplus	$383,402	$315,663	I. $67,739
Year:			
Gross earn	$19,556,687	$20,460,092	D. $903,405
Oper. expen	13,556,214	14,507,183	D. 950,969
Net earn	$6,000,473	$5,952,909	I. $47,564
Other income	638,509	644,452	D. 5,943
Total income	$6,638,982	$6,597,361	I. $41,621
Fixed charges	5,308,186	5,219,259	I. 81,827
Surplus	$1,337,896	$1,378,102	D. $40,206

The operating expenses for this year include $333,651 for new equipment and $35,365 for automatic couplers and air brakes applied to freight cars and engines in compliance with United States statutes.

Chicago & Eastern.—M. S. Carter & Co., of St. Louis, have commenced suit in the Effingham Circuit Court against this company, claiming an unpaid balance of $25,000 on the Shelbyville Southern extension, which they bulit. This extension is from Danville, Ill., Southwest to Shelbyville, 91 miles.

Columbus, Hocking Valley & Toledo.—Judge George P. Sage, of the United States Circuit Court, at Columbus, O., has rendered a judgment in favor of the Central Trust Co., of New York, in its suit to foreclose the consolidated mortgage of $14,500,000 on this road. The plea was that the company is insolvent, having defaulted the payment of $200,000 interest, due March 1. Unless the principal, interest and costs are paid within the time prescribed by law the Receiver is ordered to sell the property. Vice-President N. Monsarrat was appointed Receiver Feb. 25.

Illinois Central.—The earnings of the year ended June 30 were as follows:

Year:	1897.	1896.	Inc. or Dec.
Average miles oper...	3,130	3,068	I. 62
Gross earn	$22,110,937	$22,002,842	I. $108,095
Oper. expen	15,735,884	14,962,276	I. 773,608
Net earn	$6,375,053	$7,040,566	D. $665,513

The gross earnings for July, 1897, are estimated at $1,892,625 against $1,638,624 for the corresponding month of 1896, which is an estimated increase of $254,001. The number of miles operated in July, 1897, was 3,586, as compared with 3,130 for July, 1896, the increase of 456 miles being due to taking over the so-called "Chesapeake, Ohio & Southwestern Railroad System," consisting of the Chesapeake, Ohio & Southwestern Railroad, the Owensboro, Falls of Rough & Green River Railroad, the Short Route Railway Transfer in Louisville, the Troy & Tiptonville Railroad and the Hodgenville & Elizabethtown Railroad.

The annual meeting of the stockholders will be held at the office of the company at Chicago Sept. 15 to elect Directors and to pass upon the proposed issues of $32,000,000 of bonds to put into operation the refunding scheme detailed in this column May 28. The issues are of first mortgage 3½ per cent. gold bonds as follows: On the Springfield Division $2,000,000, payable 1951; on the St. Louis Division and Terminal $10,000,000, payable 1951; on the Louisville Division and Terminal $20,000,000, payable 1953. The stockholders will be further asked to approve of the further lease by the company of the St. Louis, Alton & Terre Haute with its leased lines, the Chesapeake, Ohio & Southwestern, the Owensboro, Falls of Rough & Green River and the Short Route Transfer.

Kings County Elevated.—Circulars have been sent to the holders of first mortgage bonds of this company, asking for power of attorney authorizing the Bondholders' Committee to bring about a foreclosure for the purpose of reorganizing and appointing as Receiver James H. Frothingham, Treasurer of the company, in place of President Jourdan. The circulars are signed by August Belmont, Chairman of the Committee; Walter G. Oakman and William A. Reid.

Leavenworth, Topeka & Southwestern.—This road, which is operated under a receiver by the Atchison, Topeka & Santa Fe, is having considerable trouble over its right of way. In 1886 traffic on the line was abandoned for two months and Judge Myers, of the Kansas District Court at Leavenworth, decided in consequence that J. G. Stone was entitled to possession of the right of way which had been taken from him when the line was built. The sheriff accordingly was ordered to fence in the roadbed and the postmaster of Leavenworth notified to send his mails by another route. Now the Atchison, Topeka & Santa Fe has torn down the fence and has caused the arrest of Mr. Stone on the criminal charge of obstructing the United States mails. The sheriff has also arrested the men who took down the fence.

Louisville & Nashville.—This company and the Germania Safety Vault & Trust Co., of Louisville, Ky., have filed a petition in the Circuit Court at Shelbyville to foreclose a $250,000 mortgage held by them to secure bonds of the Cumberland & Ohio (operated under lease by the Louisville & Nashville), on which interest has not been paid since 1883. They also gave notice that application would be made for a Receiver for the Cumberland & Ohio about Sept. 22.

Manhattan.—Earnings are reported for the quarter ended June 30 as follows:

Three Months:	1897.	1896.	Inc. or Dec.
Gross earn	$2,332,748	$2,321,813	I. $10,935
Oper. expen	1,356,524	1,385,915	D. 29,391
Net earn	$976,224	$935,898	I. $40,326
Other income	44,583	42,500	I. 2,083
Total income	$1,020,807	$978,398	I. $42,409
Charges	630,850	616,799	I. 14,051
Balance	$389,957	$361,599	I. $28,358
Dividends	300,000	300,000	.....
Surplus	$89,957	$61,599	I. $28,358

Nashville, Chattanooga & St. Louis.—The terminal facilities at Nashville, Tenn., of this road and of the Louisville & Nashville have been leased to the Louisville & Nashville Terminal Co. for 99 years. The Louisville & Nashville Terminal Co. has executed a mortgage on the property to the Manhattan Trust Co., of New York, to secure the issue of bonds not to exceed $2,000,000, running 50 years from May 1, 1896.

Oregon Improvement.—Judge Hanford has entered a decree of foreclosure in the United States Court at Seattle, Wash., of both the first and consolidated mortgages of this company. The first mortgage of $3,951,000 is declared to be a lien on all the property of the company. This decree was made at the instance of the Reorganization Committee, of which John I. Waterbury is chairman, and enables the committee to push the reorganization of the company. The plan of this committee, as presented in May, 1896, and adopted by holders of a large amount of bonds and stock of all classes, calls for the issue of $5,000,000 first mortgage 5 per cent. gold bonds, $5,000,000 non-cumulative 4 per cent. preferred stock and $9,000,000 common stock. The first mortgage bonds are to be retired upon the payment of $30 on each $1,000 and in exchange for $1,100 in new first mortgage bonds. The consolidated mortgage bonds, of which there is $6,549,000 outstanding, and the preferred stock ($310,000 outstanding) are to be retired upon the payment of 12½ per cent. of the face value, and in exchange for 62½ per cent. of the face value in preferred stock and 75 per cent. in common stock. The common stock ($7,000,000 outstanding) is to be retired upon the payment of 10 per cent. and in exchange for 10 per cent. of preferred stock and 50 per cent. of common stock. The committee has extended the time for depositing the stocks and bonds without penalty until Aug. 30. This plan of reorganization is opposed by the Consolidated Committee, of which R. G. Rolston is chairman. The company operates the Pacific Coast (80 miles), Columbia & Puget Sound (57 miles), Seattle & Northern (36 miles), and the Port Townsend Southern (43 miles), besides five steamship lines and the Franklin Coal Co.

Oregon Short Line.—The earnings for June and for the period from March 16 to June 30 are reported as follows:

June:	1897.	1896.	Inc. or Dec.
Gross earn	$586,479	$498,305	I. $88,174
Oper. expen	251,818	252,590	D. 772
Net earn	$334,661	$245,715	I. $88,946
March 16 to June 30:			
Gross earn	$1,720,797	$1,610,367	I. $110,430
Oper. expen	750,229	787,489	D. 37,260
Net earn	$970,568	$822,878	I. $147,690

Peoria, Decatur & Evansville.—The Reorganization Committee, of which Moses L. Scudder is Chairman, has notified the holders of bonds and stock of this road that the time limit for receiving bonds and subscriptions under the plan of reorganization is Sept. 1.

Union Pacific.—The earnings of the entire system have been reported for June and for the six months ended June 30 as follows:

June:	1897.	1896.	Inc. or Dec.
Gross earn	$1,455,847	$1,296,264	I. $159,582
Oper. expen	999,029	873,108	I. 125,920
Net earn	$456,818	$423,156	I. $33,662
Six Months:			
Gross earn	$8,001,492	$7,130,585	I. $870,907
Oper. expen	5,393,264	4,904,053	I. 489,211
Net earn	$2,608,228	$2,226,532	I. $381,695
UNION PACIFIC PROPER.			
June:			
Gross earn	$1,259,188	$1,128,094	I. $131,093
Oper. expen	829,217	719,115	I. 110,101
Net earn	$429,971	$408,979	I. $20,992
Six Months:			
Gross earn	$6,723,255	$6,161,069	I. $562,186
Oper. expen	4,460,089	4,091,784	I. 368,305
Net earn	$2,263,166	$2,069,285	I. $193,881

Electric Railroad News.

Allentown, Pa.—The property of the Allentown & Bethlehem Traction Co. will be sold at foreclosure. The date of the sale has not yet been fixed.

Bradford, Pa.—Action will be taken at the next meeting of the Council on the ordinance granting the Olean, Rock City & Bradford Railroad Co. the right to run its cars over the tracks of the Bradford Electric Railway Co.

Chambersburg, Pa.—The extension of time allowed the Chambersburg Electric Railway Co. to file its bond has expired and for the second time the company has neglected to perform its part of the agreement with Councils.

Chicago, Ill.—The Metropolitan Traction Co., which was recently granted a franchise to operate electric cars on many of the country roads in the vicinity of Chicago, has negotiated a loan of $2,000,000 with the Equitable Trust Co. and the State Trust Company as co trustee.

President Leslie Carter, of the Alley "L" road, has sent a request to the Commissioner for a permit to change the motive power on the road from steam to electricity.

Lincoln, Neb.—A meeting of the Lincoln Street Railway Co. will be held at 3 o'clock on Thursday of next week, at 44 Wall street, New York, to take action on a plan of agreement for reorganizing the company.

Louisville, Ky.—Judge Sage, of the United States Court, has directed the Receiver of the Cincinnati Inclined Plane Railway Co. to pay to the Louisville Trust Co. the sum of $11,250, to be used in paying coupons on the consolidated mortgage bonds of the company now overdue.

New York.—The directors of the Union Railway Co., known as the Huckleberry road, have passed a resolution to lease the 135th street line, between Eighth and Madison avenues, to the Metropolitan Traction Co. This line, which is 2,000 ft. in length, will enable the Traction company to make a complete circuit with their cars, besides affording valuable transfer privileges to the passengers.

Paterson, N. J.—On Saturday of last week an accident at the power-house of the Paterson Street Railroad Co. completely stopped the movement of street cars in that city until Monday morning. The accident was caused by the dropping of the coal bins, which had been built at the top of the building, and were filled with over 1,000 tons of coal. The power station also generated the electricity for all of the lights in the city, so that the city was left in darkness.

Philadelphia, Pa.—At the monthly meeting of the Park Commissioners held on Tuesday of this week, permission was given to the Fairmount Park Transportation Co. to mortgage its property so as to protect a contemplated issue of bonds of $500,000. The company has in its treasury $230,000 capital stock, but it is proposed to hold that amount for the present and to create the loan. A number of improvements are being made in the park by the Electric Railroad Company.

Mr. C. F. Fox has resigned as Director of the Union Traction Co., and Mr. A. J. Cassatt has been mentioned for the place.

TRAFFIC.

Traffic Notes.

The Pennsylvania now runs a refrigerator car on the local freight train twice a week, from Altoona to Philadelphia.

The Southern Pacific has put on a fast freight from Sacramento, Cal., to Portland, Or., to run through in 48 hours. A similar southbound train will also be put on.

To meet the competition of the very low rates from New York to Texas by steamer, the Southern Pacific has reduced freight rates on canned goods, wine and some other commodities from the Pacific coast to Texas. The company also announced a rate of nine cents per 100 lbs. on cotton from Houston to New York, to go by rail to New Orleans, but the State Railroad Commissioners of Texas sent a written warning to the effect that if this very low rate were continued, the Commissioners would order similar reductions on cotton going over the road to Houston and Galveston; and, according to the press dispatches, the railroad company restored the old rate of 17 cents via New Orleans.

Counterfeit Mileage Tickets.

A press dispatch from Cleveland, Aug. 14, indicates that the railroad people have got a clew to the swindlers who have been selling counterfeit mileage tickets for some time past. A woman named Mary Anderson was arrested, and in her baggage were found 43 counterfeit thousand-mile books of the Baltimore & Ohio. It is said that a man known as R. H. Lucas was an accomplice of the woman, but he eluded the police.

Taking Care of the Hog Traffic.

It never occurred to us that hog cholera had a direct connection with railroad affairs, though we have heard the term applied to the cases of certain passengers—those who occupy four seats each. Such persons certainly have some malady, though we are not sure whether it is contagious. But a press despatch from Dubuque, Ia., makes a very practical railroad question of this disease, and it is asserted that the Chicago, Milwaukee & St. Paul has during the past year distributed to the farmers along its lines a remedy for it which has saved 90 per cent. of the hogs treated. As over 3,000,000 hogs died of cholera in Iowa last year the value of a good cure or preventive is self evident.

Chicago Traffic Matters.

CHICAGO, Aug. 18, 1897.

The Sub Committee of the Executive Committee of the Western Passenger Association has recommended the adoption of the Sebastian interchangeable mileage ticket by the lines of that organization.

The new Central Passenger Association mileage bureau will begin business on Sept. 1, and on that date 1,000-mile interchangeable mileage tickets will be placed on sale, good on all the lines in that association's territory. All other mileage, with the exception of the 5,000-mile photographic ticket, will be withdrawn from sale. The Grand Trunk will not join in the mileage agreement. It is said that the laws of Michigan interfere.

At the St. Paul meeting regarding flour rates to the Atlantic seaboard all the roads denied having made any contracts at cut rates that extend beyond the month of August, and pledged themselves to absolutely maintain the 22½ cent rate after Sept. 1.

The Southwestern Traffic Association has decided to establish at St. Louis on Sept. 1 a weighing and inspection bureau.

As the result of a conference between the uniform basis of rates committee of the Central Freight Association and the Southeastern Mississippi Valley Association, a revised agreement for making through rates from Central Freight territory to Mississippi Valley common points has been adopted.

Eastbound shipments from Chicago and Chicago junctions to points at and beyond the Western termini of the trunk lines for the week ending Aug. 12 amounted to 57,116 tons, as compared with 69,255 tons the preceding week. This statement includes 23,442 tons of grain, 2,837 tons of flour and 9,833 tons of provisions, but not live stock. The following is the statement in detail for the two weeks:

Roads.	WEEK ENDING AUG. 12.		WEEK ENDING AUG. 5.	
	Tons.	p. c.	Tons.	p. c.
Baltimore & Ohio	2,918	5 1	2,668	3.9
C., C., C. & St. Louis	1,523	2 7	1,760	2.5
Erie	7,584	13.3	11,612	16.8
Grand Trunk	5,841	10 2	6,548	9.5
L. S. & M. S.	8,429	14.8	5,277	7.6
Michigan Central	13,656	23 9	9,897	14.3
N. Y., Chi. & St. L.	2,516	4.4	9,397	13.6
Pitts., Cin., Chi. & St. Louis	3,517	6.1	5,156	7.4
Pitts., Ft. Wayne & Chicago	5,774	10.1	7,773	11.2
Wabash	5,358	9.4	9,167	13.2
Totals	57,116	100.0	69,255	100.0

Lake shipments last week were 136,203 tons.